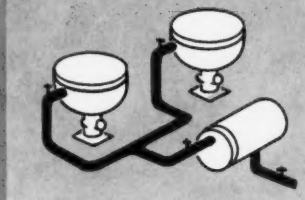
For engineers who design and manage the power and plant services

Power

MARCH 1959

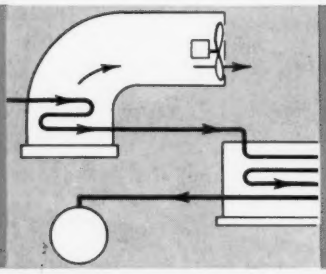
ONE DOLLAR

A McGRAW-HILL PUBLICATION



a 24-page special report

Water treatment: Part 2 65



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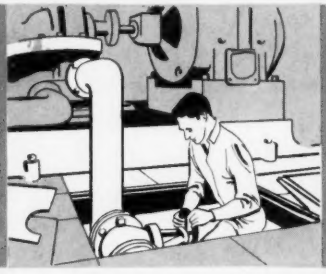

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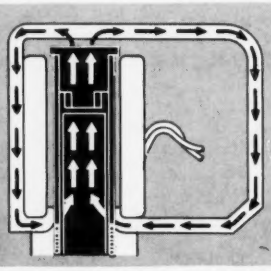

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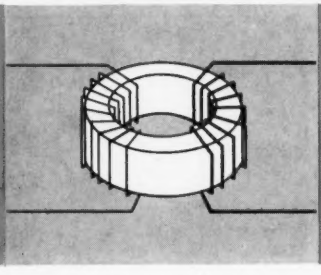

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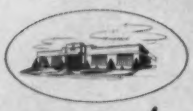
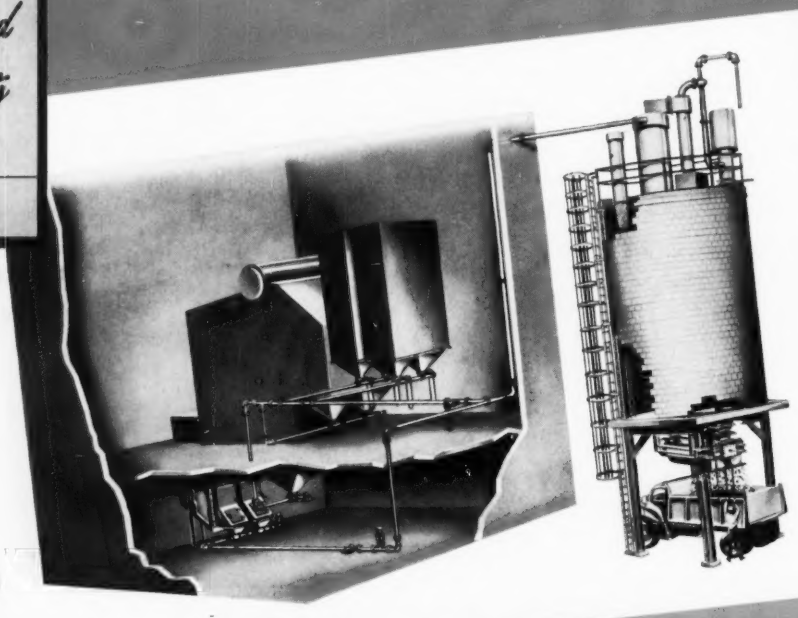


Small and Medium Sized Boiler Plants

PROPOSAL



ASHVAC A-S-H Pneumatic Bottom and Fly Ash Handling Systems*

For more than 36 years the Allen-Sherman-Hoff Company has been solving ash handling problems. The company has *project engineered* pneumatic bottom and fly ash handling systems—ASHVAC Systems—for small and medium sized boiler plants in every corner of the world.

The many systems we have installed in this period have naturally led to the standardization of many components common to most of these systems. This gives an important cost advantage to purchasers of ASHVAC Systems.

Plant layout and the design of other components do not lend themselves to standardization. These have been, and will continue to be, *project engineered* —giving the customer the advantages of "tailor-made" systems.

Control of manufacturing—A-S-H has operated its own plant since 1929—extends to the ASHVAC customer our advantages of quality control and delivery. This is also an important plus factor when repair parts are required.

If you are not familiar with the A-S-H ASHVAC Pneumatic Bottom and Fly Ash Handling System for Small and Medium Size Boiler Plants, it will be worth taking time to send immediately for our new ASHVAC literature. Then, call in your local A-S-H Field Engineer and talk with him about your problem. He's anxious to tackle your problem—no matter how small or how tough it might be.

Your first step towards better ash handling—send for Data Sheet Za—NOW.

**A-S-H service doesn't stop with installation. When service problems come up, we stand ready to give prompt service assistance. This is a policy worth considering when suppliers are being selected.*

MATERIALS HANDLING SYSTEMS

"Hydrojet" *hydraulic*

"Hydrovac" *pneumatic*

the **Allen-Sherman-Hoff** company

259 E. Lancaster Ave., Wynnewood, Pa.

Offices and representatives in principal cities

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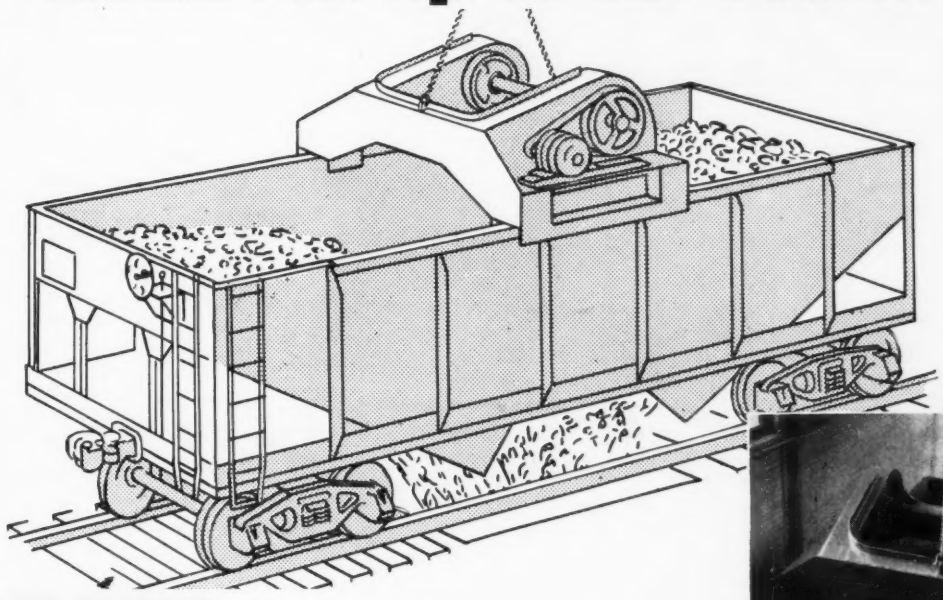
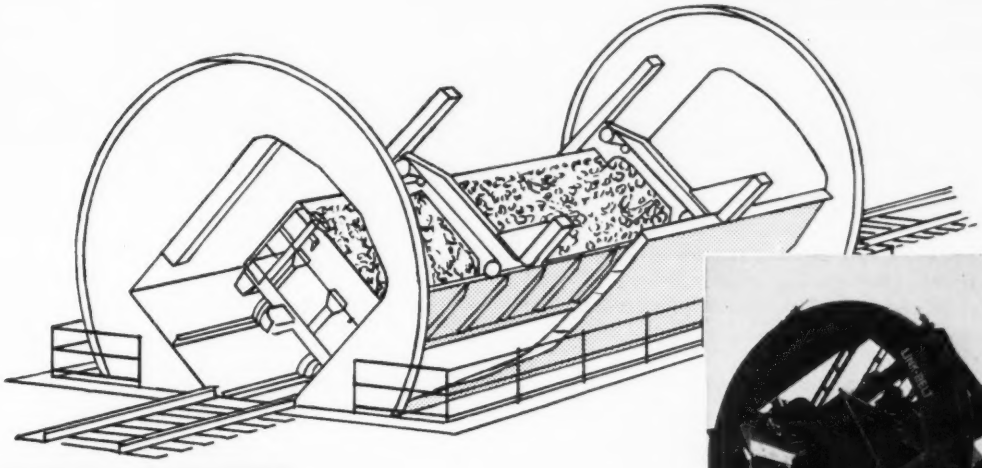
Clean sweep in car unloading!



CAR SHAKERS

FAIR SHAKE for coal cars. Wear to cars is no more than that encountered in normal operations over road bed. Objectionable noise can be reduced to a minimum. Shaker produces a series of hammer-like blows on the top of the car sides loosening even the hard-packed loads in minutes. Especially good for damp, sticky or frozen loads.



ROTARY DUMPERS

GOOD TURN for large plants. Link-Belt Rotary Dumpers empty a 90-ton gondola car every 45 to 90 seconds (including return to upright position) by simply turning car upside down. Car is securely held in rotating cradle and contents are completely dumped in one operation. Simple, automatic, fool-proof. Takes all open-type cars—any length, width or height.

Only LINK-BELT makes both shakers and dumpers . . . broom-clean unloading for any plant capacity

You can meet any coal unloading need with equipment by Link-Belt. For large operations a Link-Belt Rotary Dumper will unload 20 or more cars per hour. For smaller plants, Link-Belt Car Shakers are available. Both are engineered to do a specific job faster . . . easier . . . at lower cost. Both reduce operational hazards and cut costly demurrage charges.

Call your nearest Link-Belt office. We'll be happy to give you additional facts on Link-Belt Car Shakers and Rotary Dumpers.

LINK-BELT

CAR SHAKERS AND ROTARY DUMPERS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 14,057

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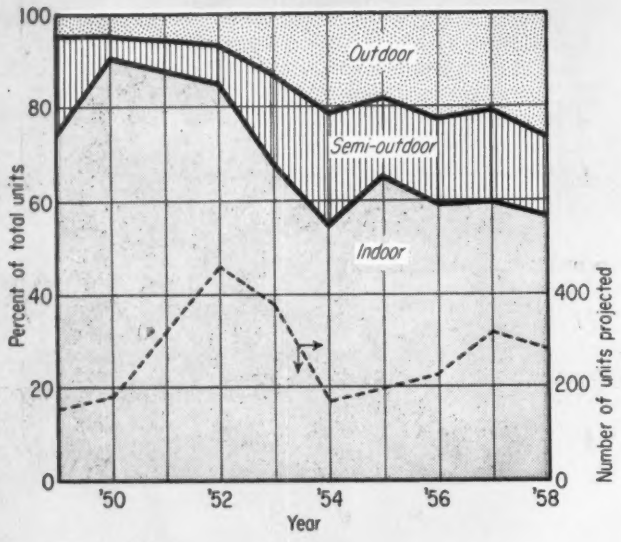

Plant surveys, a POWER feature for over 25 years, continue to serve in a variety of ways. For example, Associate Editor Ben Skrotzki thumbed through past tabulations of new and expanded central stations to background a talk he gave before ASME. He came up with the above plot.

The Power-to-Grow . . . *electrically* article (Feb, p 66) stemmed directly from data in past POWER tabulations. This time the surveys pointed up a statistical shift toward self-ownership of primary substations by industrial plants.

A consulting engineer recently spent several hours in our office poring over surveys. He carefully noted each industrial installation where elapsed time indicated possible modernization . . . and new business for him.

If you want a bound copy of POWER's design surveys, 1953-1958, ($2.50), indicate so on Reader-Service Card, p 122. We'll bill you later.

Lou Rowley

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B&W Pulverizer Design Simplicity Cuts Maintenance

A Compact, Space-Saving Package of Efficient Grinding Power

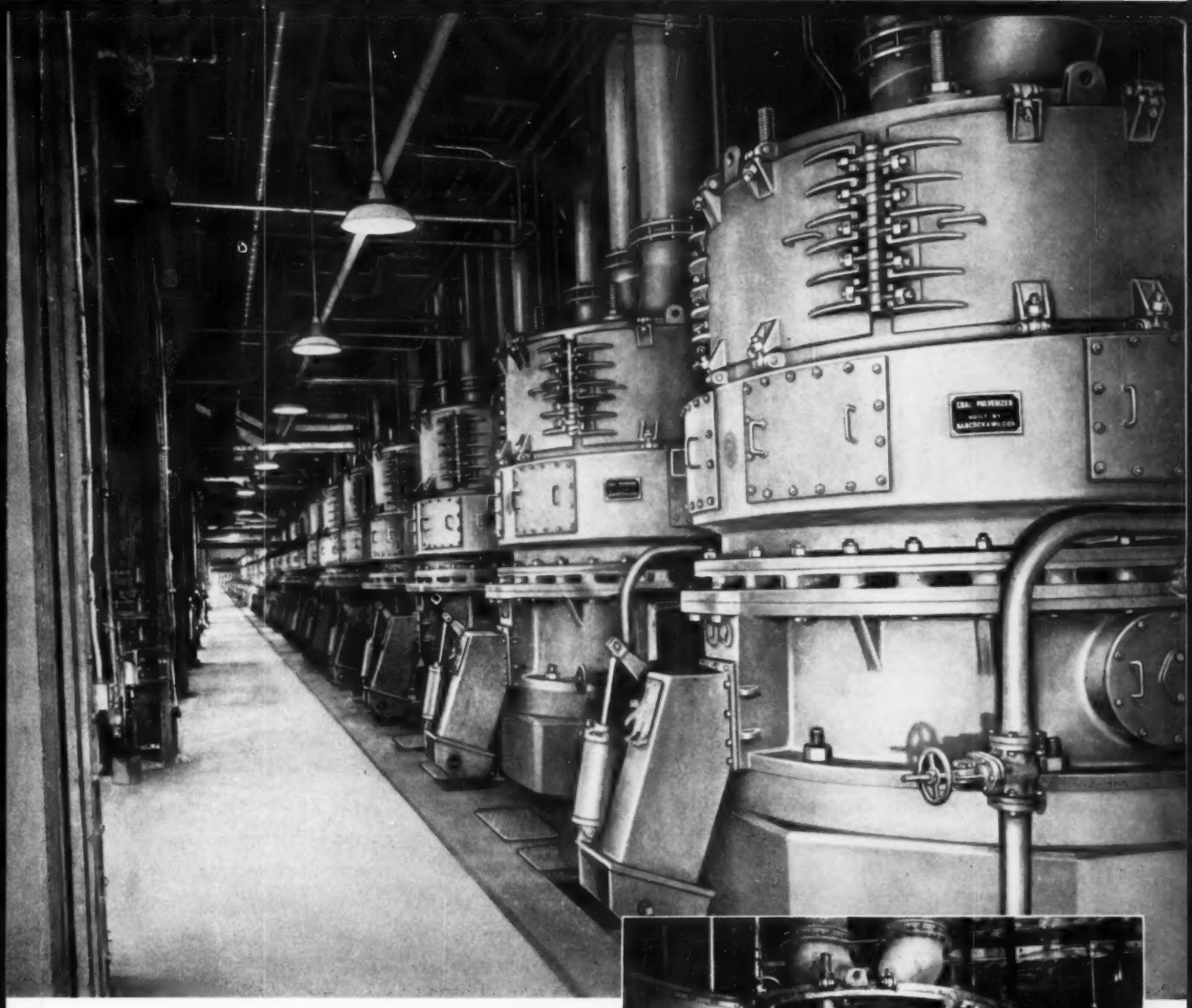
Exceptional output and efficiency records . . . highlighted by low maintenance . . . have been established in hundreds of installations by B&W Pulverizers. Their long-range dependability has been accompanied by reduced operating costs.

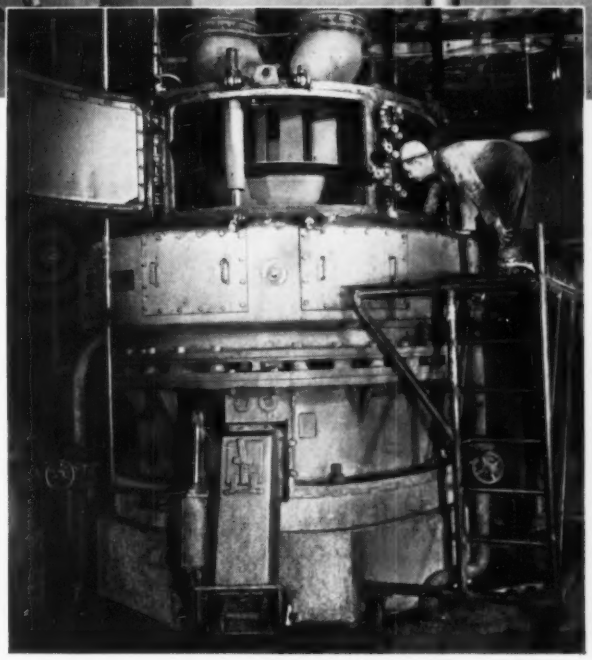
Simplicity of Arrangement and Reduced Maintenance: Accessibility for all normal maintenance makes it simple, quick, safe, and low-cost. Adjustments are easily made while the unit is in operation. Using only clean primary air supplied under pressure, fan maintenance is substantially reduced and fuel piping is greatly simplified. Also, with the pulverizer acting as its own distributor, no special distributing devices are needed. Grinding elements are of special alloy material. They last two years or more on eastern coals and at least a year on midwestern coals.

Continuous High Fineness Over Entire Service Life: Efficient combustion requires high fineness at all times. The high circulating load of the B&W Pulverizer permits efficient and dependable classification of product, so that only material of proper fineness leaves the unit. In addition, its slow-speed, spring-loaded ball bearing grinding elements maintain proper grinding contact throughout their service life.

Handles Wide Variety of Low Grade and Wet Coal: Regardless of the coal's grade or whether it's dry or soaking wet, the B&W Pulverizer's unique and exclusive recirculation of fuel through heated air assures efficient grinding . . . eliminates shutdown, capacity loss, or special attention from operators.

Adaptable to All Types of Automatic Controls: Because it features "one point contact with the





(Above) Part of the 42 B&W Pulverizers serving six B&W Open-Pass Boilers. (Right) Maintenance is simple: doors open wide, classifier and spring assemblies are readily accessible for removal. Grinding components are lifted without special rigging.

boiler," operation of the B&W Pulverizer is simple. The boiler's automatic combustion control is connected to the pulverizer at only one point—the damper in the primary-air duct. The pulverizer's own control system regulates all other functions, such as maintenance of proper fuel-air ratio and operating temperature.

SEND FOR DATA. For full information about the B&W Pulverizer and Pulverized-Fuel Firing Systems, write: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W

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BOILER DIVISION

G-924

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DIAMOND

...NOW READY AND ABLE TO IMPROVE the CLEANING of—

Shot cascading over horizontal tubular surfaces and through vertical air heater tubes, does an excellent job of removing soot and ash deposits from difficult-to-clean surfaces and those which foul rapidly.

Shot Cleaning has proved itself in more than 30 installations in the United States and in more than 800 installations in Europe. Many installations represent exceptionally difficult cleaning problems such as tubular air heaters, economizers and superheaters in black liquor fired boilers in paper mills. In a large central station, the system is now keeping air heaters clean which previously had to be water washed approximately every eight months, each washing requiring a three day boiler outage. With Diamond Shot Cleaning, draft losses are uniformly low and water washing has been eliminated entirely.

Shot is spread by distributors and cascades over tube surfaces ricocheting from tube to tube, or from side to side of internal surfaces of vertical air heater tubes. Much of the ash removed is carried off by flue gas. Heavier particles fall into the shot hopper and recirculate with the shot until broken fine enough to pass out with the gases. Shot accumulated in the hopper is lifted pneumatically to the storage area and reused continuously. Areas which tend to foul rapidly can be kept completely clean by increasing the length of the shot cycle (it can be continuous if necessary) without disturbing boiler operation.

Over a period of years Diamond has conducted extensive research in shot cleaning, as a part of our half century policy of providing the best in boiler cleaning. To supplement this program, Diamond has acquired U.S. rights to the Broman-Ekstrom system used in Europe.

WRITE FOR BULLETIN 2145 ON
DIAMOND-BROMAN SHOT CLEANING

Diamond Gives You
BETTER BOILER CLEANING
At Lower Cost

Diamond

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

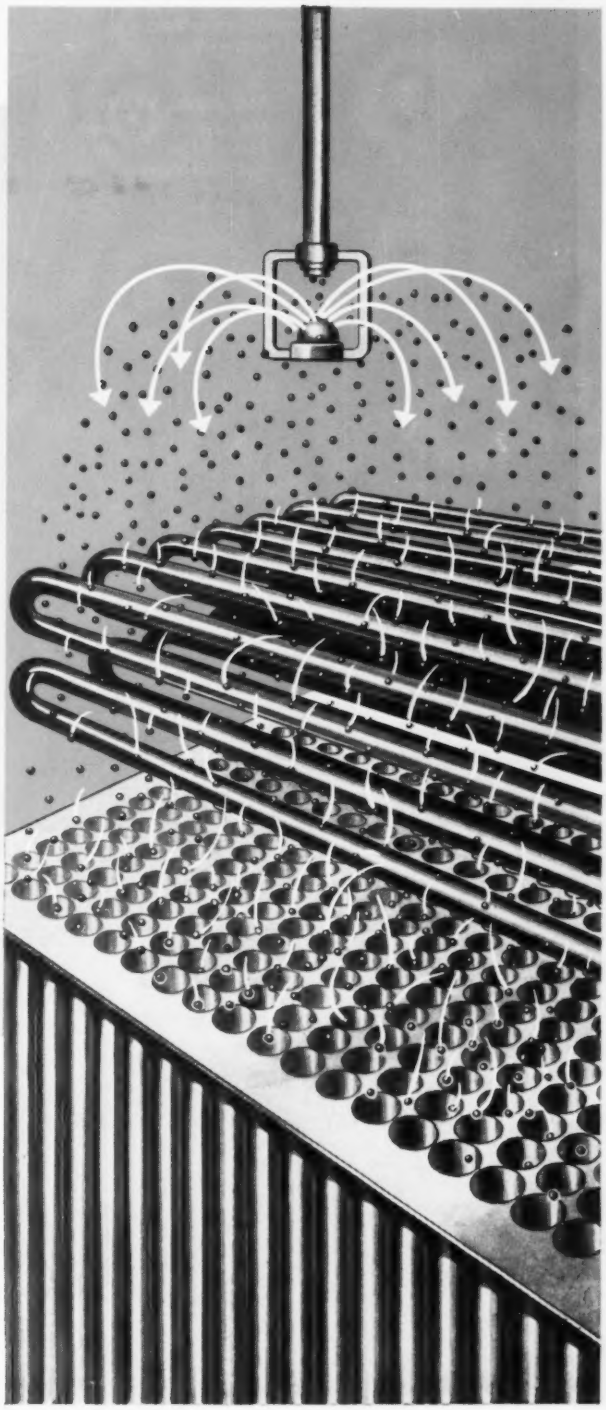
Shot Cleaning System

TUBULAR AIR HEATERS

ECONOMIZERS

HORIZONTAL SUPERHEATERS

REHEATERS



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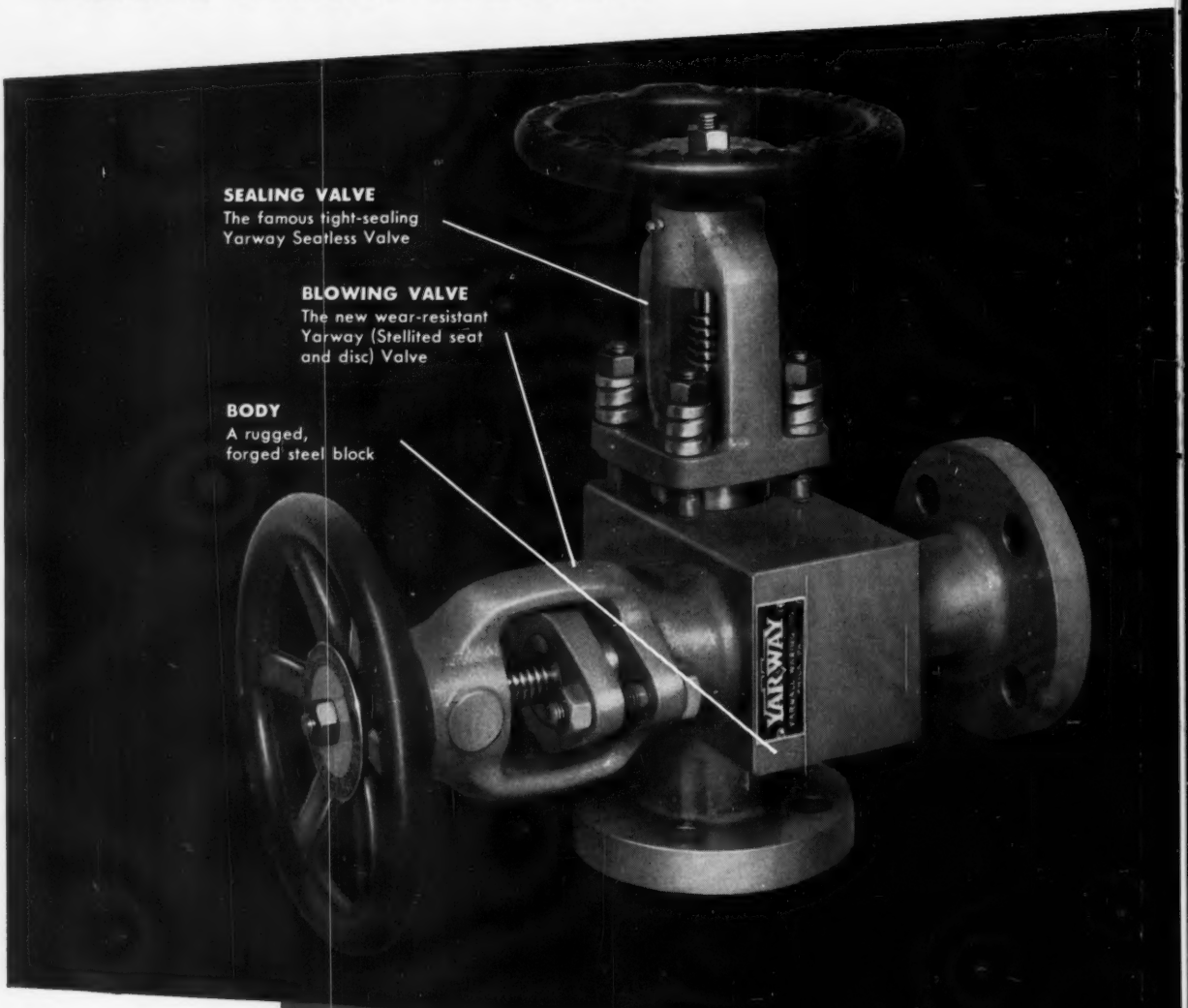
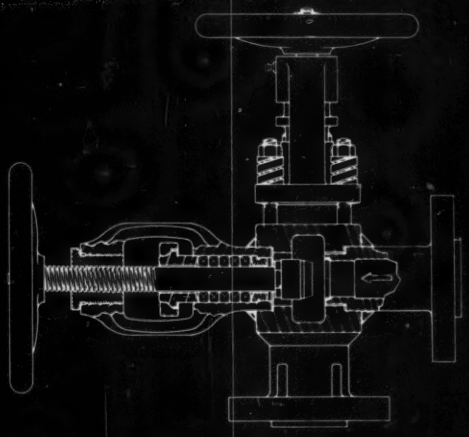
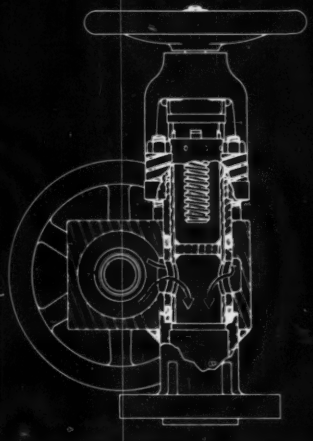


NOW! A NEW YARWAY BLOW-OFF VALVE FOR



Cross-section of medium pressure Unit Tandem Valve showing hard-seat blowing valve in open position.



Cross-section showing seatless sealing valve in open position. Flanged ends shown, welding ends also available.

UNIT TANDEM MEDIUM PRESSURE BOILERS

There's a new star in the Yarway Blow-Off Valve line.

For years rugged Yarway Unit Tandem Blow-Off Valves have been standard equipment on most high pressure boilers. In fact, more than 80% of high pressure plants use Yarways.

Now a *new design* Unit Tandem is offered for *medium pressure boilers to 665 WSP.* Streamlined, lighter in weight, easy to operate, tight sealing and long wearing —this valve brings premium quality Yarway Unit Tandem dependability to the medium pressure field— *at a competitive price!*

Important features, like the nitralloy plunger in the sealing valve and integral stellite seat and disc in the blowing valve, make this your best buy for blow-off service.

Order Yarway Unit Tandems for your present boilers— or specify them on new boilers.

For full details write for Yarway Bulletin B-435, Supplement A.

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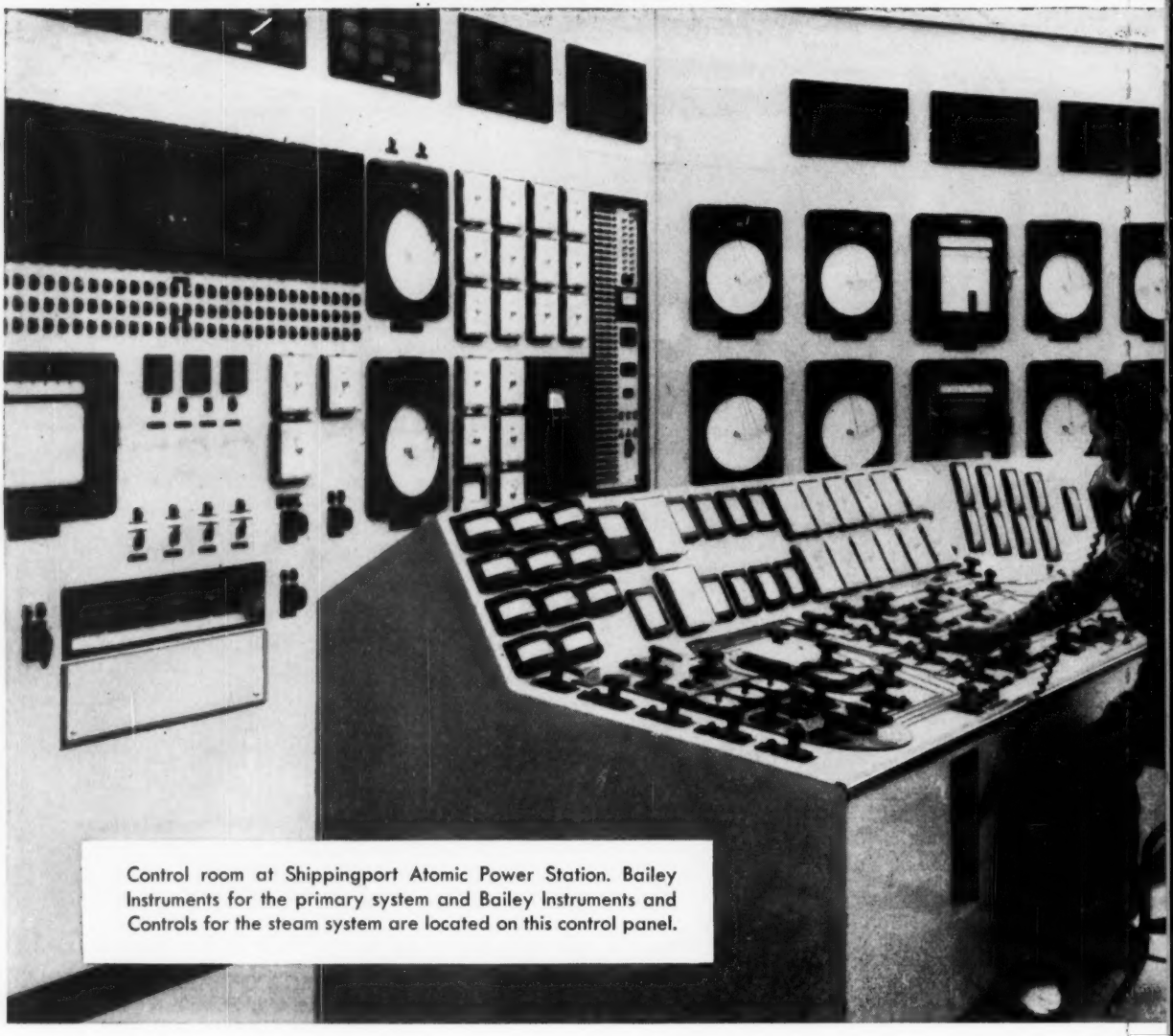


Control room at Shippingport Atomic Power Station. Bailey Instruments for the primary system and Bailey Instruments and Controls for the steam system are located on this control panel.

Bailey pioneers the control of . . .

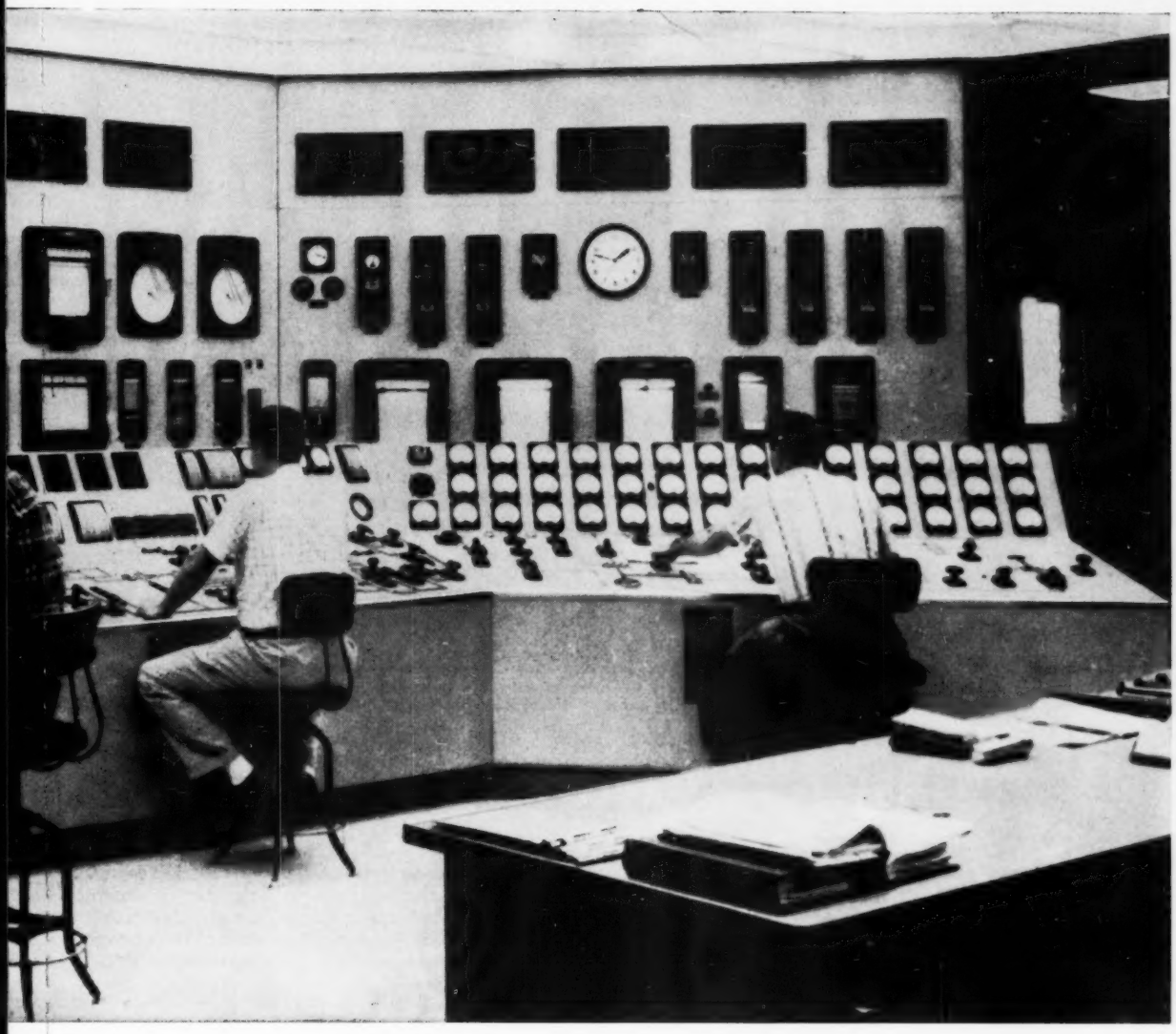
This control room is the center of operations for the world's first full-scale atomic, electric power plant devoted exclusively to civilian use—the Shippingport Station, jointly owned by Duquesne Light Company and the Atomic Energy Commission.

Here, as well as on the atomic-powered submarines, are Bailey Instruments and Controls performing dependably hour after hour, month after month.

In conventional power plants, too, Bailey Meters and Controls are standard equipment. Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion and automatic control are your assurance of the best possible system.



ATOMIC STEAM POWER PLANTS

2. Experience

Bailey engineers have been making steam plants work efficiently for more than forty years. Veteran engineer and young engineer alike, the men who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A136-2

Instruments and controls for power and process

BAILEY METER COMPANY

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In Canada—Bailey Meter Company Limited, Montreal

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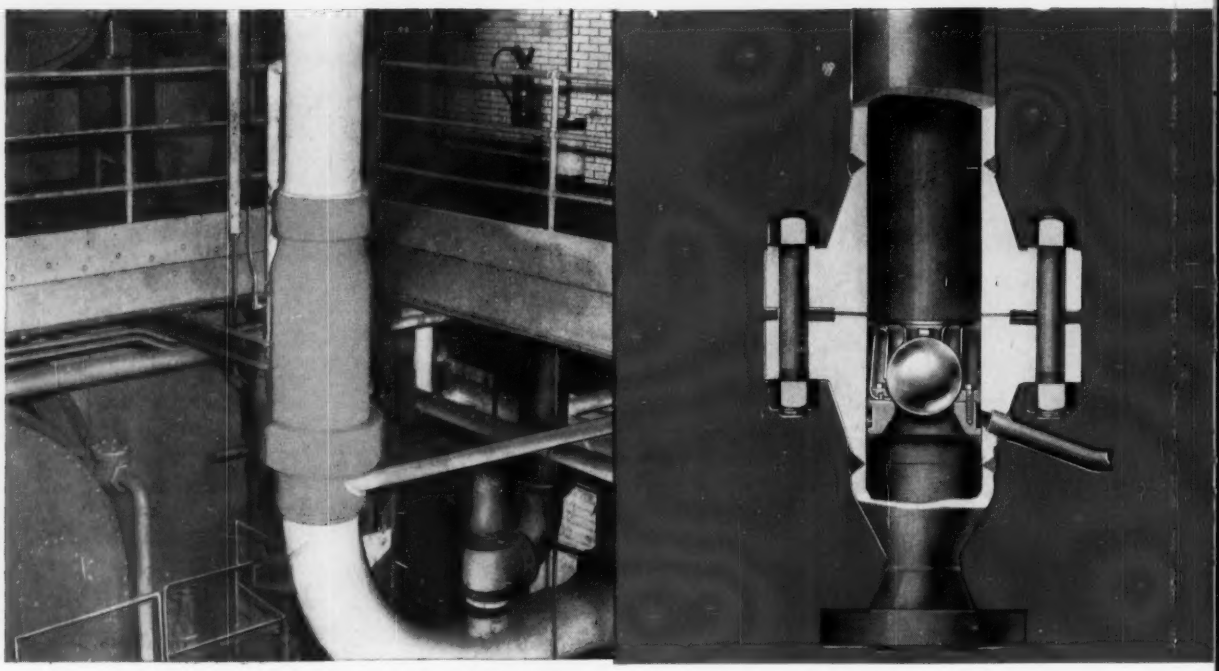


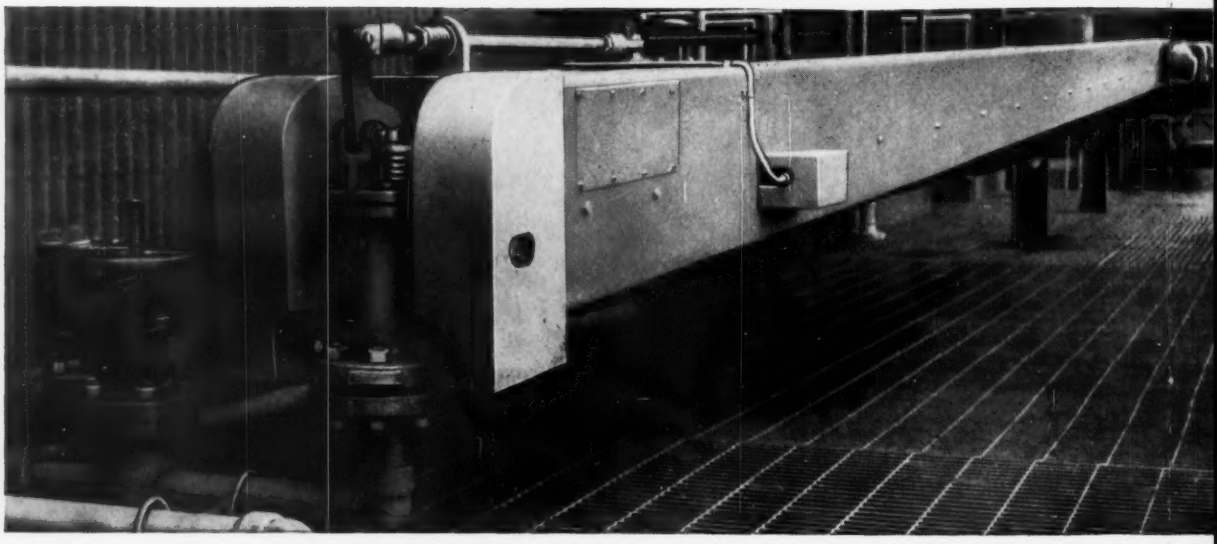
New Variable-Orifice Desuperheater holds reduced steam temperatures constant only 20 feet downstream from desuperheater outlet—regardless of changes in initial temperatures or rate of flow. No long runs of piping or spray nozzles are required. Other types are available, each engineered to particular operating requirements for steam service conditions through 2500 psig and 1100 degrees F. Write for Bulletin 1037.

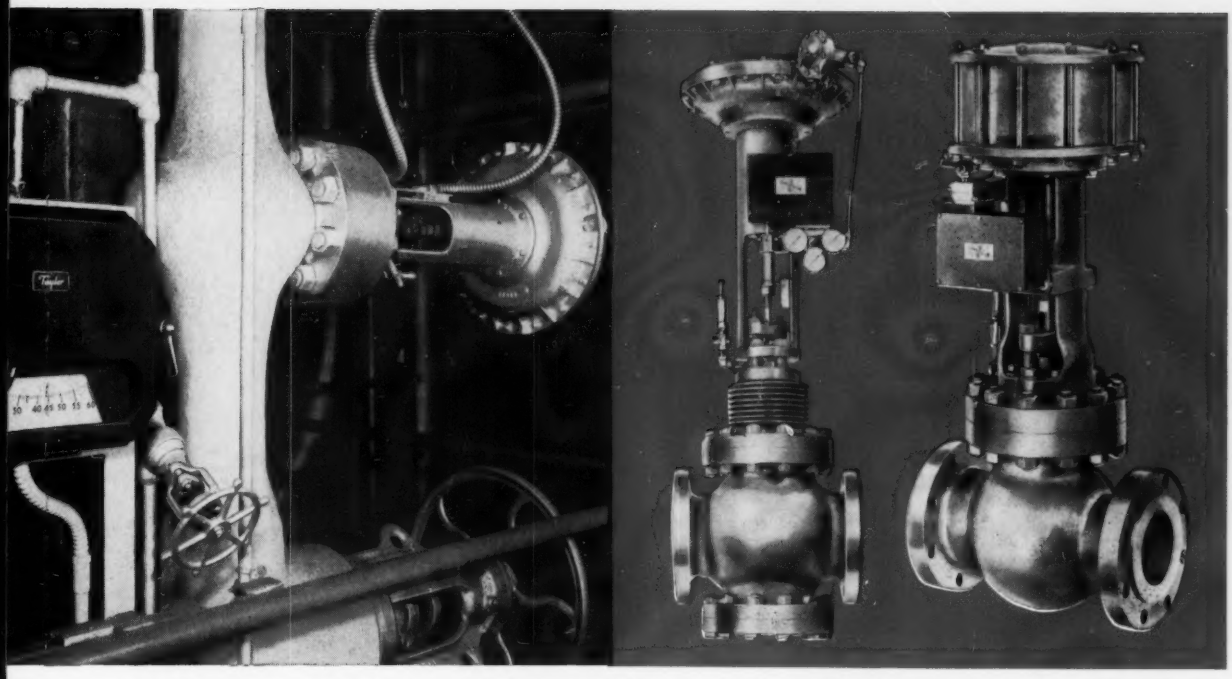
Copes-Vulcan equipment

With the country's electric power demand doubling every decade, power plants must operate with higher and higher efficiency. Boiler and boiler controls must be more closely integrated than ever before.

To meet these needs, Copes-Vulcan produces a complete line of control systems for superheat and reheat temperatures, feedwater, combustion, pressure reducing and desuperheating operations. Available in separate units or integrated into a single package, these control systems are custom-engineered to meet individual specifications, and are backed by more than 50 years design experience in the field.

Automated soot blowing. Vulcan Selective-Sequence Control Panel (at right) permits varying the operating sequence of electrically-driven soot blowers. Also available: Automatic-Sequential systems. Write for Bulletin 1029. The 35 foot Vulcan T-30 Soot Blower (below) has a dual-motor drive for thorough cleaning of all surfaces. Part of a complete line of soot blowers and wall deslaggers. Write for Bulletins 1030, 1034.





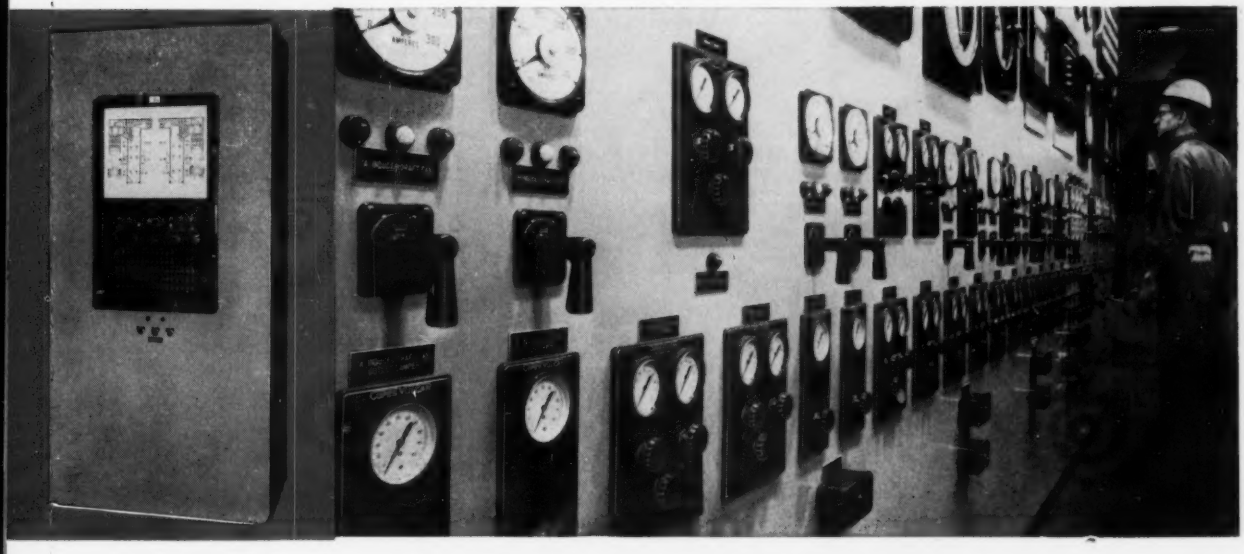
Boiler feed pumps are protected by this Copes diaphragm-operated by-pass valve. Also available: piston-actuated valves for use where valve operating force must be unusually high, and positioning precise. Both types, designed to meet pressure standards of 125-pounds through 2500-pounds, offer excellent rangeability. Each is job tailored for accuracy and dependability. Write for Bulletin 1027.

boosts power plant* efficiency

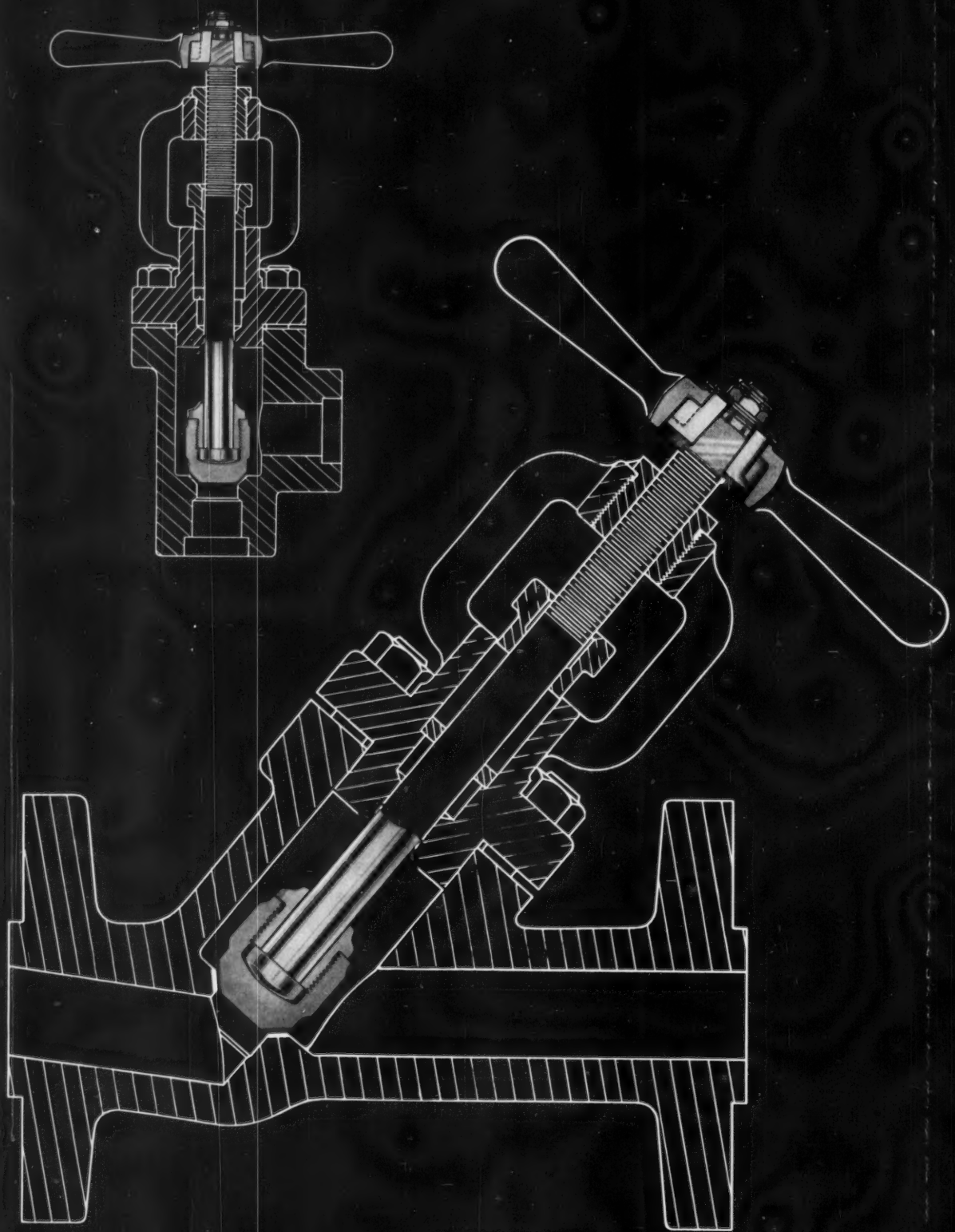
***Thermal and nuclear:* besides intensive commercial product development, Copes-Vulcan is skilled and experienced in the design and manufacture of special products such as valves for the Navy's nuclear submarine program and for nuclear-powered electric generating stations.**

COPES-VULCAN DIVISION
Blaw-Knox Company, Erie 4, Pa.

Boiler control provides high speed response, simplicity of circuits and accuracy of components. Graphic panels centralize boiler operations at operator's fingertips. Combustion control may be from steam flow-air flow, or from fuel-air ratio. Feedwater control may be from one, two or three influences to maintain a stabilized water level regardless of changes in load or feed pressure. Write for Bulletin 1038.



For more facts circle 208 on Reader Service Card, p 122



EDWARD FORGED STEEL BLOW-OFF VALVES

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Edward Drop Forged Blow-off Valves

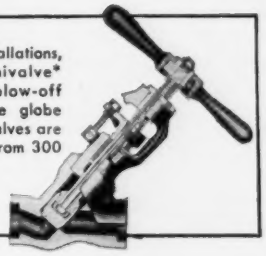
. . . the first—and still the newest!

Fifty years ago, when boilers operated at 250 lb sp the first really efficient means of blowing-down was with "new" Edward blow-off valves. Today, with pressure in the 1800-2600 lb range and with water temperatures sometimes exceeding 600 F, corresponding improvements in Edward blow-off valves have been effected. For example, today all Edward blow-off valves have integral Stellite seats and Impactor* easy closing handles.

All over the world, high temperature-pressure steam power stations rely on these Rockwell-built Edward blow-off valves. The reasons are basic. Edward valves are simple and rugged in design, with no "trick construction." They operate easily, stay tight, need very little maintenance. If parts replacement is ever necessary, repairs are easier and less expensive than with any comparable valve. Write for facts on performance, price, and delivery. Address *Edward Valves, Inc., 1230 West 145th Street, East Chicago, Indiana.* (Subsidiary of Rockwell Manufacturing Company.) Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame St. W., Montreal 1, Quebec.

Recommended practice: Open valve *nearer* boiler first. Then slowly open other valve. After blow-off, close second valve first; then valve nearer boiler. This places greatest wear on blowing valve, assures a tight valve next to boiler, facilitates repair without a boiler shut-down.

Popular for high pressure installations, the Edward welded-bonnet Univalve* meets Code requirements for blow-off service and is ideal all-purpose globe valve as well. Edward blow-off valves are available in all pressure classes from 300 lb to 2500 lb in angle or straight-way styles, with flanged or welding ends.



Premium Features of Edward Blow-off Valves

- INTEGRAL SEAT of chromium-cobalt-tungsten alloy. Applied directly to body in a continuous ring, then machined in same set-up with bonnet guide bore for perfect alignment. Highly resistant to abrasion and corrosion.
- HARD-FACED DISK—Stellited for maximum resistance to abrasion and corrosion. Edward swivel-disk construction allows stem to lift vertically away from seat. No grinding or galling.
- POSITIVE BACKSEAT isolates packing from the high temperature zone. Line-contact backseat seals EValpak* valve packing from line pressure, permits repacking under pressure.
- IMPACTOR HANDLE, an Edward exclusive, is standard equipment. Several times more effective than ordinary handles or handwheels in opening or closing valves.

EDWARD STEEL VALVES

another fine product by

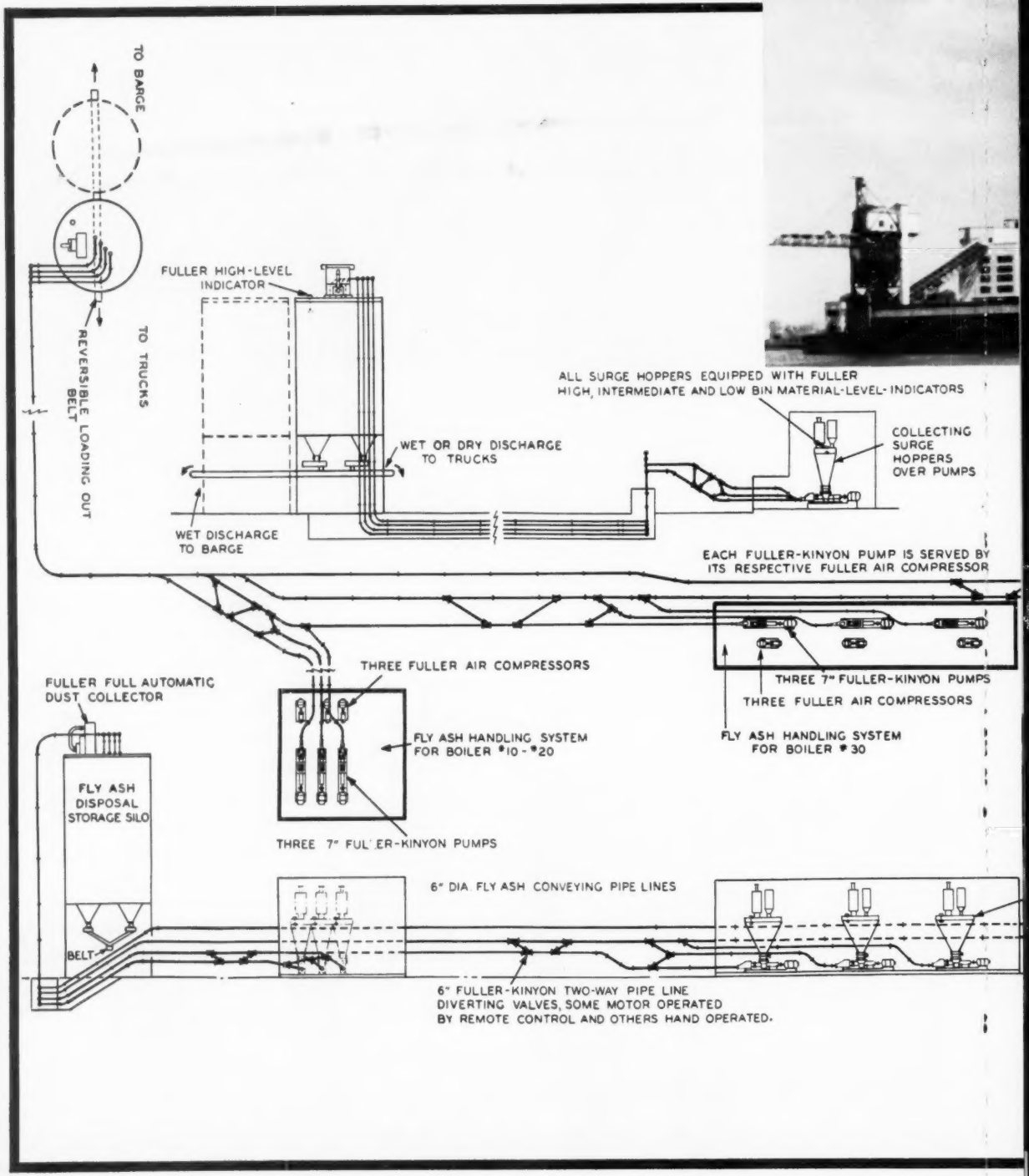
ROCKWELL

Edward builds a complete line of forged and cast steel valves from ⅛" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

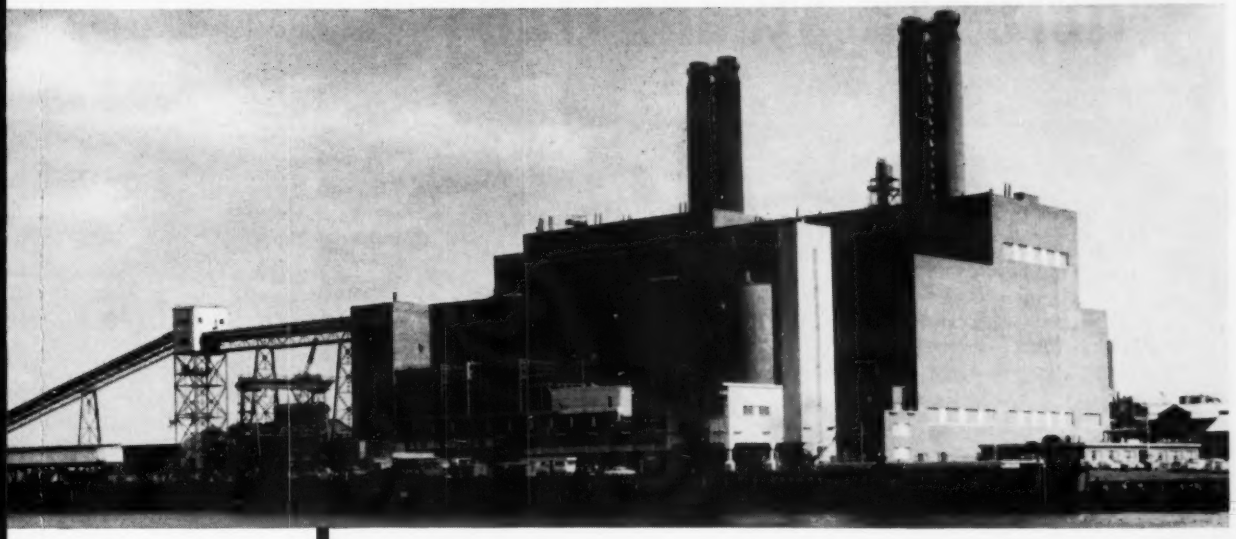
*T. M. Reg. U. S. Pat Off.

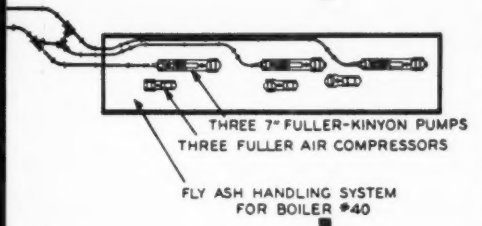
For more facts circle 209 on Reader Service Card, p 122

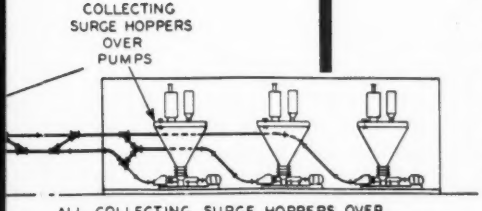
SUCCESS OF PRESENT FULLER LEADS TO REPEAT ORDERS AT


TO BARGE
TO TRUCKS
REVERSIBLE LOADING OUT BELT
FULLER HIGH-LEVEL INDICATOR
WET OR DRY DISCHARGE TO TRUCKS
WET DISCHARGE TO BARGE
ALL SURGE HOPPERS EQUIPPED WITH FULLER HIGH, INTERMEDIATE AND LOW BIN MATERIAL-LEVEL-INDICATORS
COLLECTING SURGE HOPPERS OVER PUMPS
EACH FULLER-KINYON PUMP IS SERVED BY ITS RESPECTIVE FULLER AIR COMPRESSOR
THREE 7" FULLER-KINYON PUMPS
THREE FULLER AIR COMPRESSORS
FLY ASH HANDLING SYSTEM FOR BOILER #30
THREE FULLER AIR COMPRESSORS
FULLER FULL AUTOMATIC DUST COLLECTOR
FLY ASH HANDLING SYSTEM FOR BOILER #10 - #20
FLY ASH DISPOSAL STORAGE SILO
THREE 7" FULLER-KINYON PUMPS
6" DIA FLY ASH CONVEYING PIPE LINES
BELT
6" FULLER-KINYON TWO-WAY PIPE LINE DIVERTING VALVES, SOME MOTOR OPERATED BY REMOTE CONTROL AND OTHERS HAND OPERATED.

FLY ASH HANDLING SYSTEMS CON EDISON'S ASTORIA STATION







ALL COLLECTING SURGE HOPPERS OVER FULLER-KINYON PUMPS ARE SERVED BY SEPARATE CONVEYING SYSTEMS DIRECT FROM PRECIPITATOR HOPPERS

The Astoria Station of Consolidated Edison, in New York City, is expanding to meet the increasing power needs of its industrial and residential community. Here three Fuller fly ash systems are now handling up to 35 tons of fly ash, per hour, per system. Consolidated Edison has specified another Fuller system for its forthcoming new boiler.

Fly ash collecting at Consolidated Edison has been effectively streamlined. Much of the ash is first removed from the gas stream by a mechanical precipitator. The remaining small particles of ash left in the gas stream are trapped by an electrostatic precipitator into other collecting hoppers. From the hoppers the ash is transferred by vacuum to a collecting transfer bin which discharges into the Fuller system. This ash is conveyed to a dock silo, where it is wet down and hauled away by trucks or barges. The entire operation is automatic, economical and highly efficient.

Handling of fly ash with Fuller systems offers significant advantages to the cost-conscious power plant operator. Industry surveys point to an increased use and value of fly ash in the near future, and increased specification of fly ash by both federal and state highway agencies.

Both large and small plants can gain the advantages of Fuller fly ash handling at low cost. Capacities range from 100 to 8000 cubic feet an hour. Why not take advantage of Fuller pneumatic conveying in your plant? Write today for complete information.

1383
G 209 T

Because of Astoria Station's physical layout, pipelines (through which the ash passes) go underground to base of storage silo and then ascend vertically to the top in an enclosed elevator shaft. Fuller-Kinyon conveying systems can be tailored in a similar manner to the requirements of any installation . . .

FULLER COMPANY
GENERAL AMERICAN
TRADE MARK

FULLER COMPANY
126 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation
Birmingham • Chicago • Kansas City • Los Angeles • New York • San Francisco • Seattle

Fuller
. . . . pioneers in harnessing AIR

For more facts circle 210 on Reader Service Card, p 122

Here's a steam trap

..and for seven sound reasons:

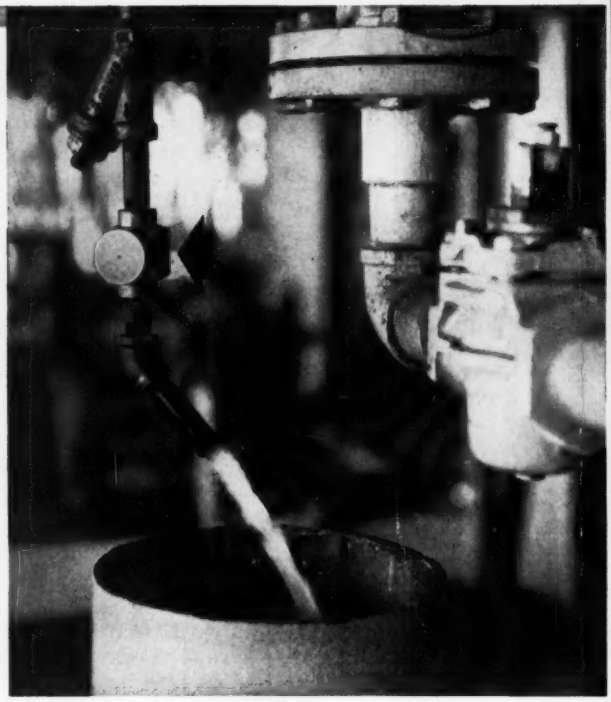
1. *Simplicity* – only one moving part.

2. *Maintenance* – practically zero. 3. *One trap* for all pressures from 10 to 600 psi.

4. *Uniform performance* – operates equally well on heavy, light, or no condensate load.

5. Operates against *back pressures* up to 50% of inlet pressure. 6. *Rugged* – unaffected by superheat, water hammer, vibration, or corrosive condensate. 7. *Minimizes inventory* of spare parts.

Sarco TD's on outdoor blending tanks of Shell Oil Company, Sewaren, New Jersey, are installed vertically, instead of in the usual horizontal position, in order to drain coils after shut-down, thus preventing freezing.



1. DRAINS AND VENTS

at start-up. Immediately rids lines of condensate and air to permit normal operation. This eliminates the need for manual opening of valves to drain the system.

CONTROL COSTS

In these days of sharp emphasis on cost control, Sarco Thermo-Dynamic TD Traps are helping plants to deliver the full productive power of every pound of steam. And because the TD has no mechanism . . . no gaskets . . . no narrow channels to clog, maintenance cost on the TD is almost nil. As one plant engineer puts it: "This TD is a cinch to install, it's no bigger than a tee fitting, and it works in any position. The TD is the one steam trap we can install and forget."

CHOOSE THE RIGHT TRAP

There's an infinite variety of applications, temperatures, pressures and loads in industrial steam piping. Sarco can help you select the right trap for every job of air and condensate removal, saving you money and down-time.

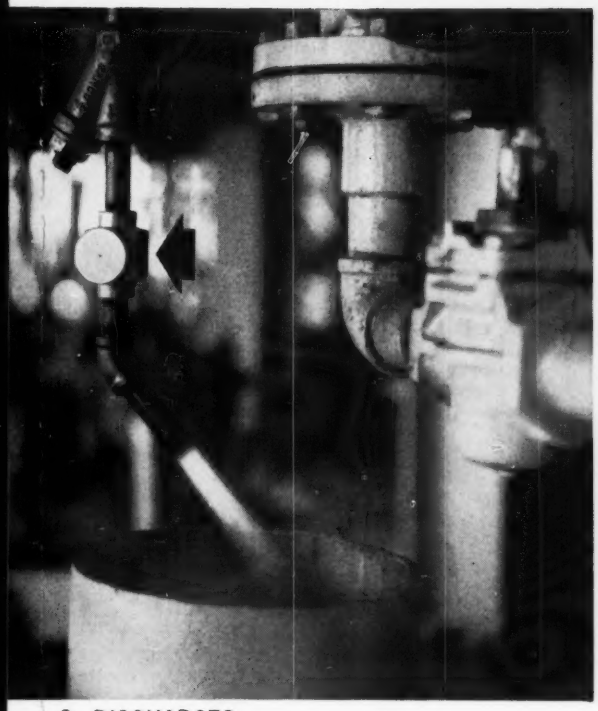
HOW ABOUT THE BUCKET TRAP?

With the development of the patented* Sarco Thermo-Dynamic Steam Trap, the bucket trap suddenly aged 50 years. In a nostalgic way we feel somewhat sorry, because *our* Sarco bucket trap has made us thousands of friends. But frankly, it's no match for the new Sarco TD. Progress is progress.

Some of our customers who are getting satisfactory service from our bucket traps may prefer to replace their old Sarco bucket traps with *new* Sarco bucket traps. If you feel this way, we're flattered enough to keep on making Sarco Bucket Traps – strong, sturdy and durable as ever. Let us suggest, however, that you at least give the new Sarco Thermo-Dynamic Steam Trap a try, under your most exacting conditions.

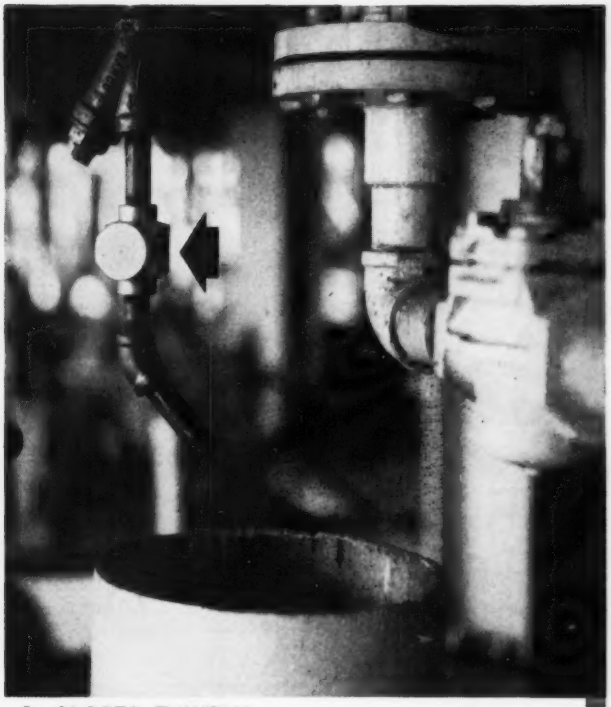
*U.S. Pat. No. 2,817,353 T. M. Reg. U. S. Pat. Off.

that does what a steam trap should



2. DISCHARGES

air and condensate at steam temperature as rapidly as they collect. Does not wait for a bucket of steam to leak through a small orifice.



3. CLOSES TIGHTLY

There is no continuous bleed; nor is there loss of buckets of steam as in the bucket trap which must discharge steam with each cycle.

MAINTENANCE TIME: 40 SECONDS!

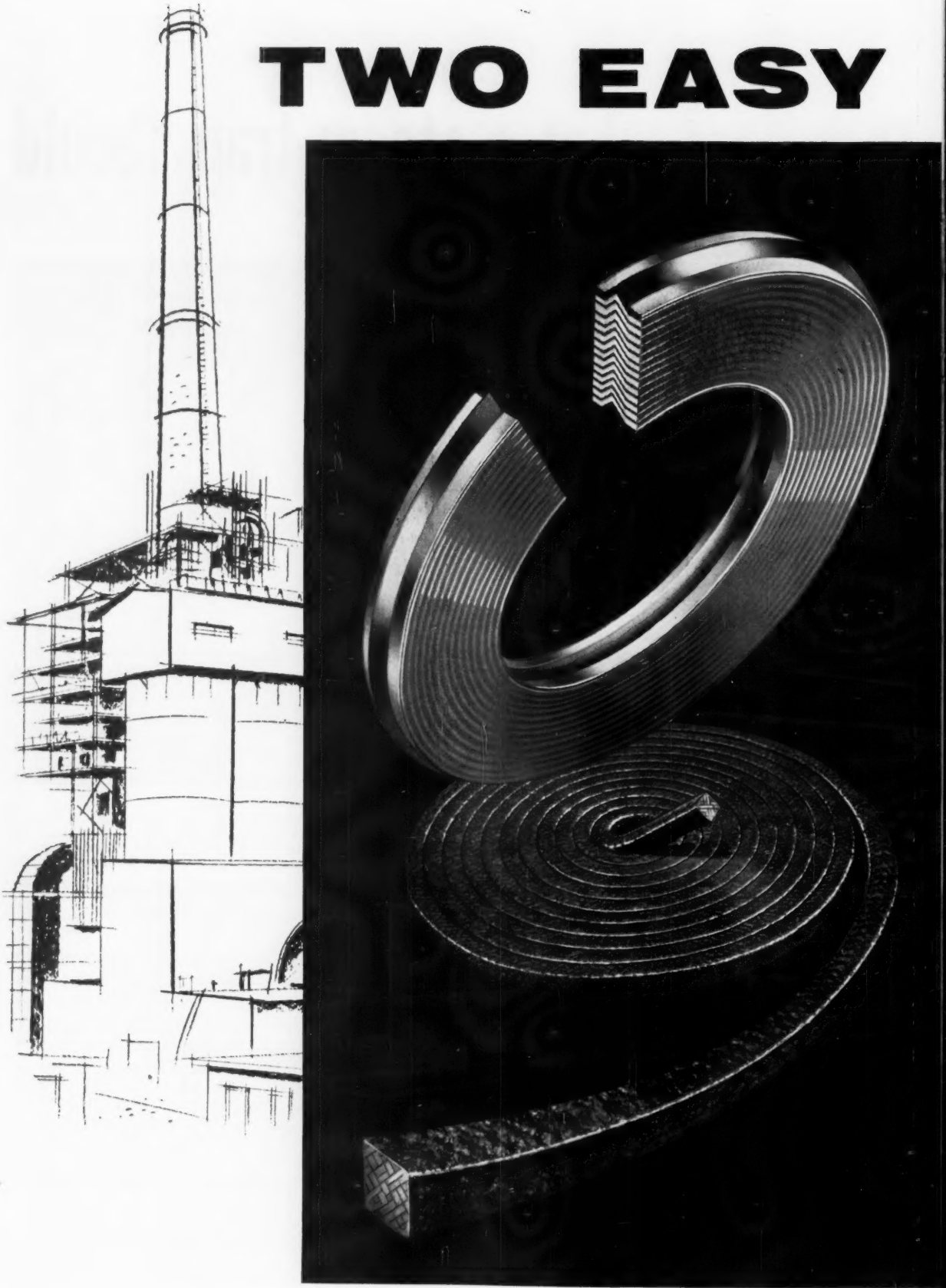
How long does it take your maintenance crew to service an ordinary trap? If it's over a couple of minutes, you're throwing away valuable time. The Sarco TD can be cleaned, blown out, if necessary, and reassembled on the line, in as little as 40 seconds. 6345-B

Sarco can give you impartial advice on trap selection because Sarco makes All–5 Types:
Thermo-Dynamic . . . Thermostatic . . . Liquid Expansion . . . Float Thermostatic . . . Camlift Bucket

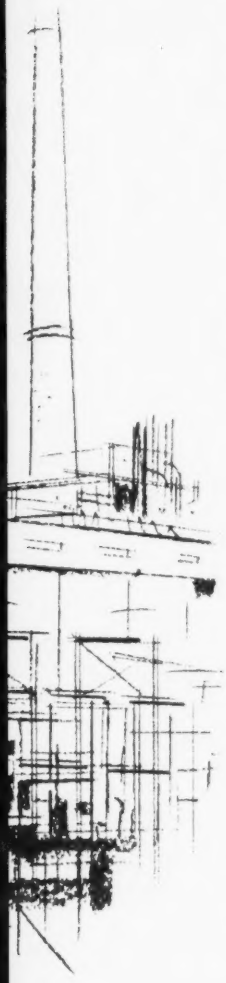
SARCO COMPANY, INC. 635 Madison Avenue, New York 22, N. Y.

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

TWO EASY



WAYS TO REDUCE POWER PLANT MAINTENANCE



Now, more than ever, power engineers and maintenance men specify Garlock GUARDIAN* Gaskets and LATTICE-BRAID* Asbestos Packings for safe, long lasting prevention of equipment failure due to high pressures and temperatures. Here are their reasons:

GARLOCK GUARDIAN GASKETS

adjust themselves automatically to maintain positive seal when pressures and temperatures change. No need to retighten bolts periodically. They are constructed of spiral wound strips of V-shaped steel, alternated with layers of asbestos . . . this enables GUARDIAN Gaskets to "spring" back to shape after compression. Also permits using lower bolt loads. Use them on boiler manholes, handholes, tube plates, and pipe flanges, where pressures rise as high as 2500 psi, temperatures to 1050° F. Available in round, oval, square, oblong, diamond, and pear shapes; practically any size and in thicknesses 1/8", .175", and 1/4". Write for Catalog AD-104.

GARLOCK LATTICE-BRAID ASBESTOS PACKINGS

require less gland pressure than conventional packings; accordingly, they require adjustment less often. Moreover, LATTICE BRAID outwears all conventional packings thus reducing downtime for repacking. Why? Because LATTICE-BRAID is made of a through-and-through braided construction; each strand passes diagonally through the packing body at a 45° angle, resulting in a unified structure of greater strength. The strands hold together even when the packing is worn far beyond the limits of ordinary braided packings. Next time, repack reciprocating rods or pump shafts with LATTICE-BRAID. See for yourself why so many others use LATTICE-BRAID asbestos packing against steam, oils, gases to 700° F. Write for Catalog AD-131.

Both these products are part of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need. The only complete line . . . that's why you get unbiased recommendations from your local Garlock representative. Call him for further information.

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

*Garlock Trade Mark

GARLOCK

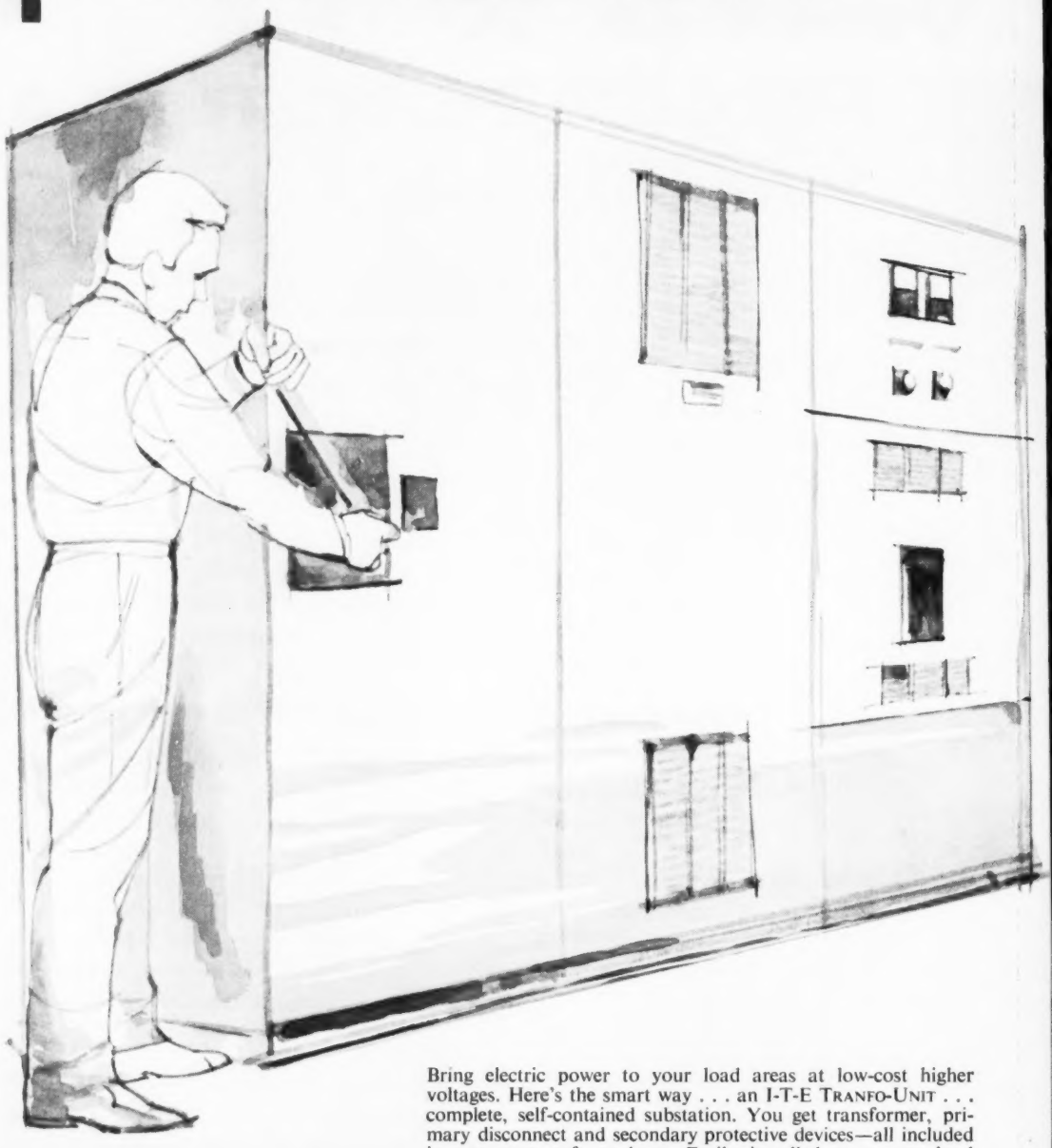
Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

CANADIAN DIVISION:
The Garlock Packing Company of Canada, Ltd.

PLASTICS DIVISION:
United States Gasket Company

For more facts circle 212 on Reader Service Card, p 122

I-T-E CIRCUIT BREAKER COMPANY



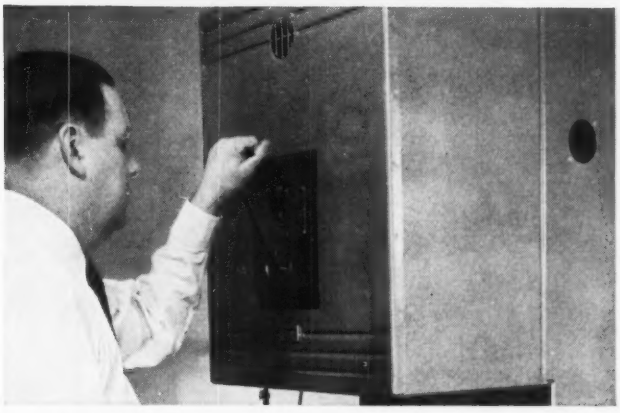
SMART

Bring electric power to your load areas at low-cost higher voltages. Here's the smart way . . . an I-T-E TRANFO-UNIT . . . complete, self-contained substation. You get transformer, primary disconnect and secondary protective devices—all included in one neat, safe package. Easily installed near your load centers. Improves motor performance and lighting efficiency . . . slashes line losses.

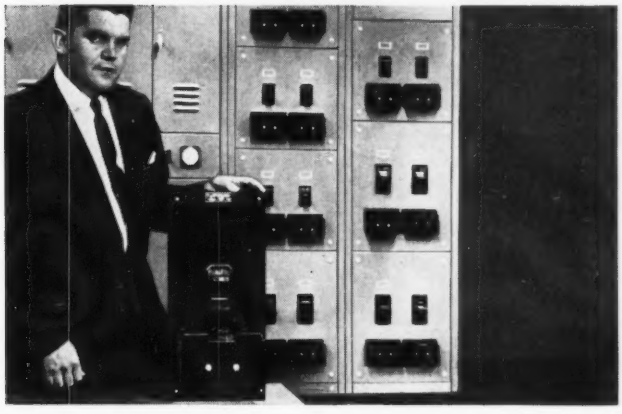
An I-T-E TRANFO-UNIT costs no more than hodgepodge arrangements of assorted gear. But it looks so much better. It's safer. And it makes possible significant economies. For example, it's delivered in one piece . . . saving installation expense. Wide choice of components means complete design flexibility. So you can meet your own requirements exactly. Available in the industry's widest range of kva ratings.

Applications for which an I-T-E TRANFO-UNIT is particularly suited include: small industrial loads, warehouses, hospitals, schools, office and commercial buildings. When you install electrical equipment for such uses, benefit from the advantages of the I-T-E TRANFO-UNIT. They are typical of the advantages you get in all I-T-E equipment. Yet when you buy I-T-E, you pay no more. Why buy anything else?

Metal-clad switchgear you can be proud of. Extra sturdiness for longer life. Extra craftsmanship for finer appearance. Extra safety for greater personnel protection. All components completely accessible. Even rear doors are hinged. Advanced design, uniform-flux-density coils mean extra protection against heavy current faults.



600 volt value package. New URELITE® individually enclosed I-T-E K-line circuit breaker—world's most advanced. Main disconnect contacts visible through side window for extra safety. Pull-down handle action provides quick manual make for safety and long contact life. New wide-range overcurrent trip device lets you increase breaker setting when your load increases. No parts to replace.



Saves 50% switchboard space. I-T-E CORDON® circuit breaker provides up to 100,000 amp interrupting capacity with molded case construction. Costs approximately ⅓ less than alternative devices. Available in sizes for many applications, loose or individually enclosed.

I-T-E Circuit Breaker Company
1900 Hamilton St., Phila. 30, Pa.

- ☐ Low voltage switchgear
- ☐ Metal-clad switchgear (5 and 15 kv)
- ☐ Secondary unit substations
- ☐ Outdoor substation structures
- ☐ TRANFO-UNITS
- ☐ URELITE circuit breakers
- ☐ Small air circuit breakers
- ☐ CORDON circuit breakers
- ☐ Power switching centers

Name..... Title.....

Company.....

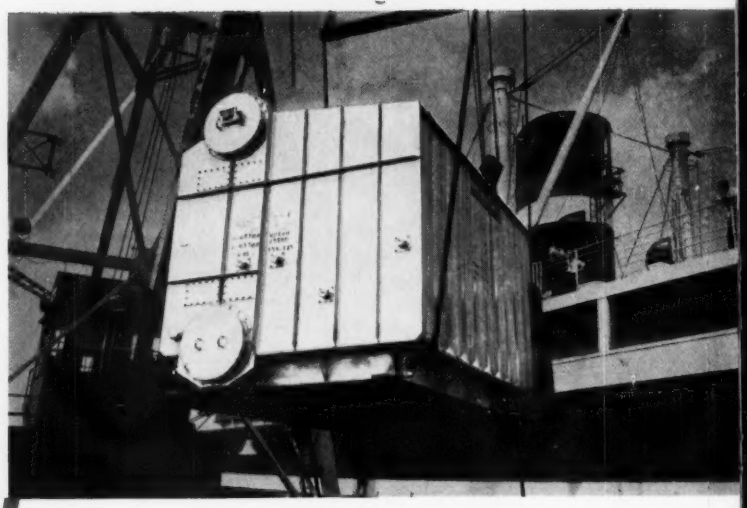
Street.....

City..... Zone..... State.....

SEND COUPON

Get full details on specific I-T-E equipment. I-T-E engineering assistance is at your disposal.

For more facts circle 213 on Reader Service Card, p 122



A C-E Package Boiler, Type VP, en route to Europe. This boiler type is available with capacities from 4,000 to 90,000 lb of steam per hr, with pressures to 700 psi and temperatures to 750 F in certain sizes. It is designed for oil or gas firing. Several hundred of these units are now in service.

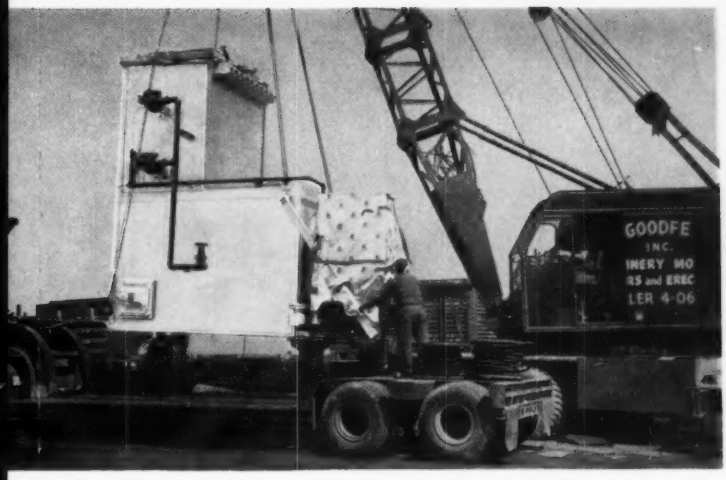
NOW C-E offers LARGER SHOP-ASSEMBLED BOILERS

Three service-proved designs with capacities to 120,000 lb

The economies inherent in shop-assembled boilers can now be yours even if your steam requirements are as high as 120,000 lb per hr. The C-E line, consisting of three basic unit types, has been expanded to include pressures, temperatures and capacities well beyond normal package-type limits.

The standard, natural-circulation, ***C-E Package Boiler—Type VP***—is now available with capacities to 90,000 lb per hr, and with pressures and temperatures to 700 psi and 750 F. Where greater steaming capacity is required, or where higher pressures or temperatures are needed for industrial processing or power generation, the shop-

A shop-assembled Controlled Circulation Boiler, Type PCC, being prepared for shipment. This type unit is available with steam capacities from 80,000 to 120,000 lb per hr, and with pressures and temperatures to 1000 psi and 900 F. For special applications, designs are available to provide higher steam pressures and temperatures. Seven PCC Boilers are now in service.



A shop-assembled C-E High-Temperature Water Boiler, Type HCC, being unloaded at a midwest manufacturing plant. It is one of two 12-million-Btu boilers used for plant heating. Available for capacities from 10 million to 300 million Btu, this unit type is shop-assembled in sizes up to 50 million Btu for oil or gas firing — up to 40 million Btu for coal firing. Currently, more than 50 HCC Boilers are in service or on order.

per hr...pressures to 1000 psi...temperatures to 900 F

assembled ***C-E Controlled Circulation Boiler — Type PCC*** — is available. It is designed for the 80,000-to-120,000-lb capacity range, with pressures to 1000 psi and temperatures to 900 F. For special applications, this unit is also available for considerably higher pressures and temperatures.

The C-E High-Temperature Water Boiler — Type HCC—is an ideal type for large space-heating and certain process uses. It is also available in shop-assembled form for capacities to 50 million Btu per hr. It is designed for pressures to about 500 psi, and can provide water at 450 F or higher.

The new, high-capacity ranges of these shop-assembled units represent the logical evolution of familiar and successful designs that have been proved in service for quality, economy and performance.

Catalogs on any or all of these units available on request.

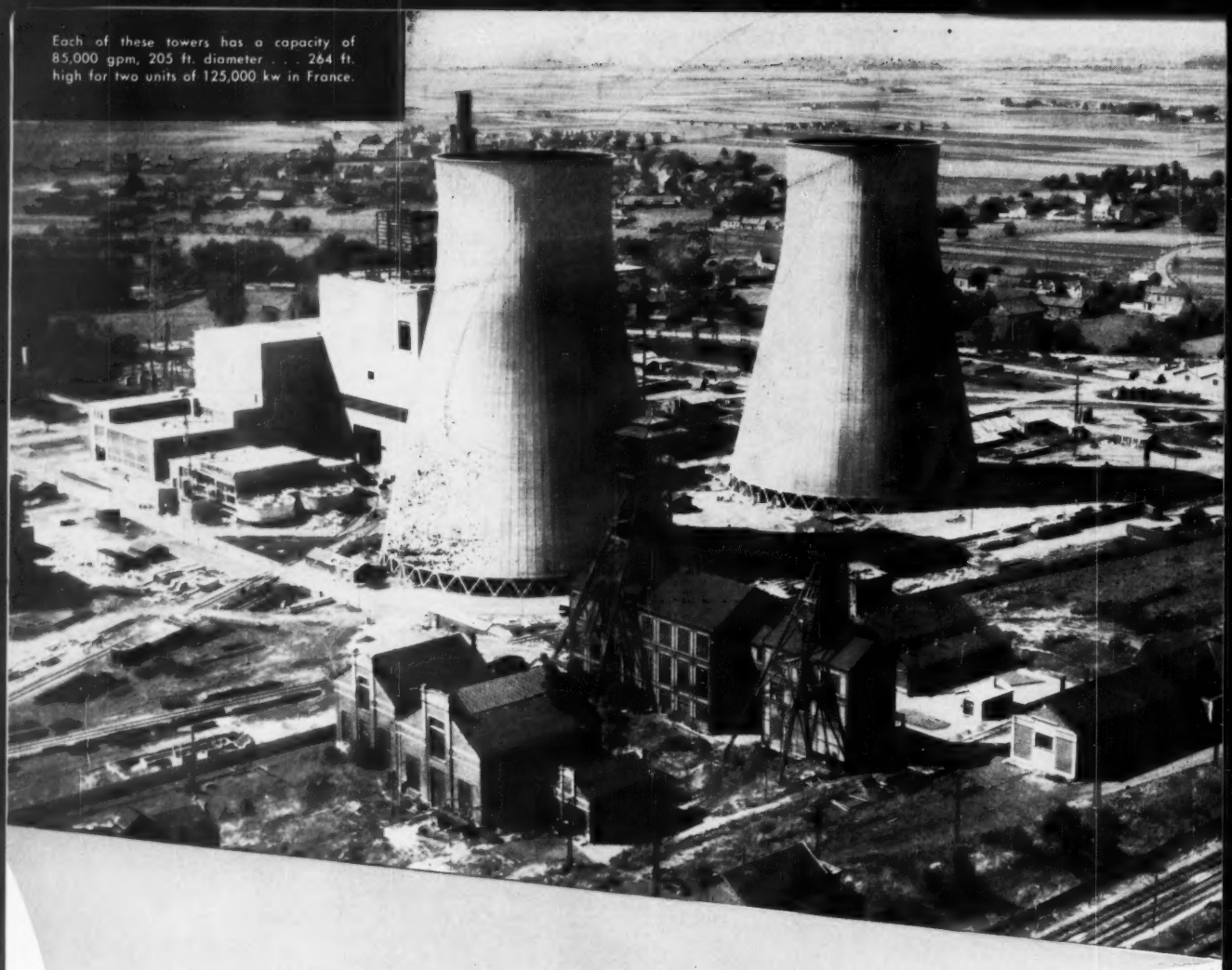
COMBUSTION ENGINEERING

C-202

Combustion Engineering Building • 200 Madison Ave., New York 16, N. Y.

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more facts circle 215 on Reader Service Card, p 122 ➤



Each of these towers has a capacity of 85,000 gpm, 205 ft. diameter . . . 264 ft. high for two units of 125,000 kw in France.

AIR DRAFT SELF GENERATED INSIDE A REINFORCED CONCRETE STACK UP TO 350 FEET HIGH

FILLING & HOT WATER DISTRIBUTING NET OF ASBESTOS CEMENT SUPPORTED BY REINFORCED CONCRETE FRAMEWORK

NO MOTORS	NO ELECTRIC POWER CONSUMED
NO GEARS	NO MECHANICAL MAINTENANCE
NO FANS	NO REPAIRS NOR BREAKDOWNS

ONLY PERMANENT MATERIALS - NO WOOD -
LONG LIFE EXPECTANCY - NO FIRE HAZARDS
NO MAINTENANCE - NO INSURANCE

MISTS DISCHARGED HIGH ABOVE THE GROUND
NO GROUND FOGGING - NO ICE COATING IN SWITCH YARDS
NO RECIRCULATION
EFFICIENCY UNDIMINISHED AT ZERO WIND

HAMON, Inc.

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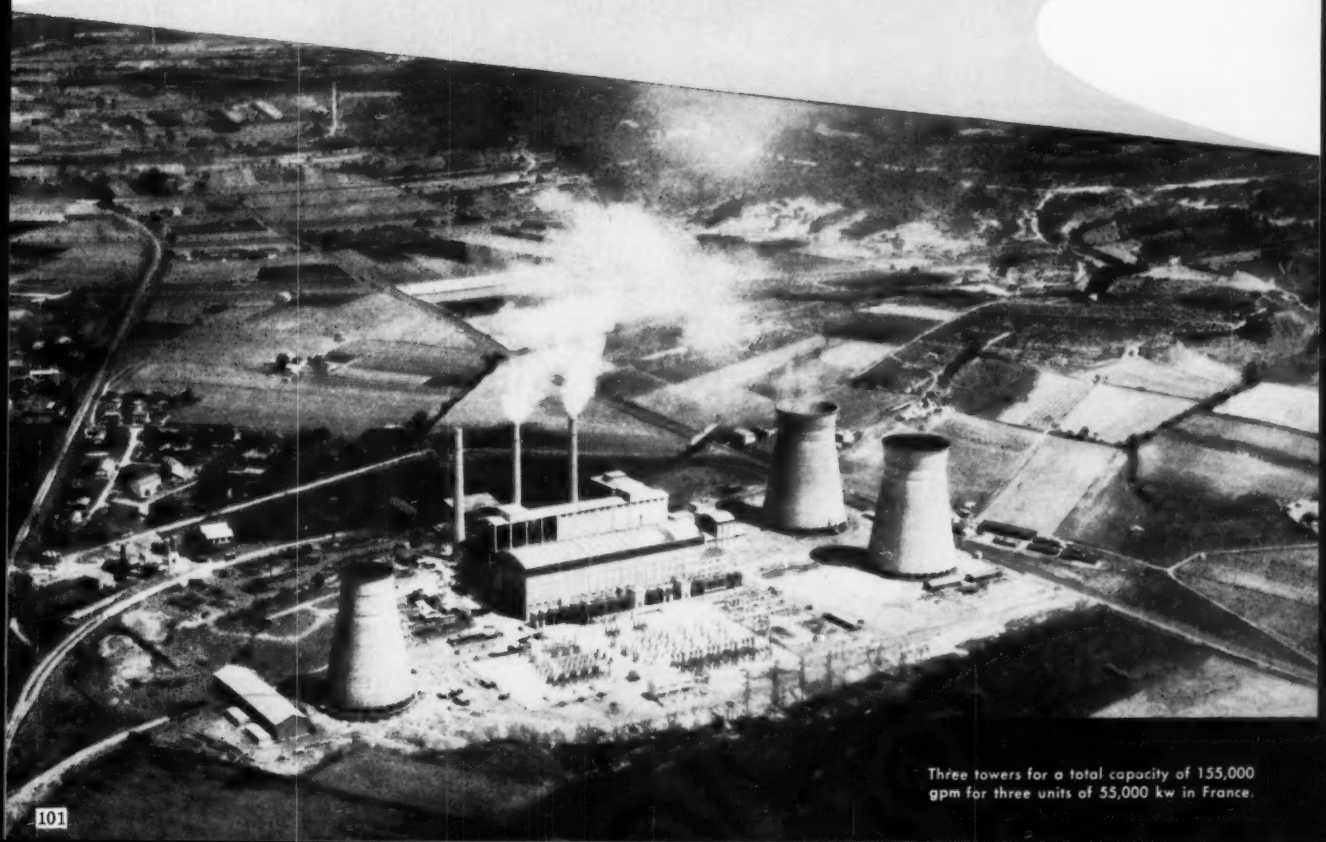
HAMON

NATURAL DRAFT COOLING TOWERS

HALF A CENTURY
OF EXPERIENCE!..

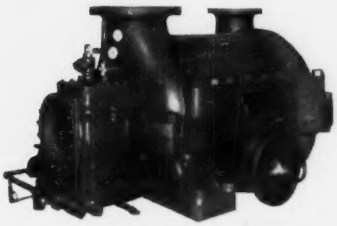


Three towers for a total capacity of 155,000 gpm for three units of 55,000 kw in France.

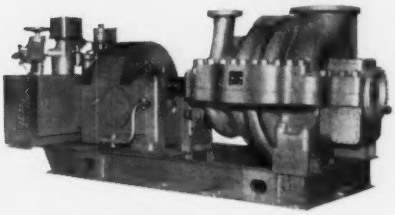
John L. Parris, *Manager Centrifugal Compressor Sales, The Cooper-Bessemer Corporation, explains...*

How you gain four ways when you specify Cooper-Bessemer Centrifugal Compressors

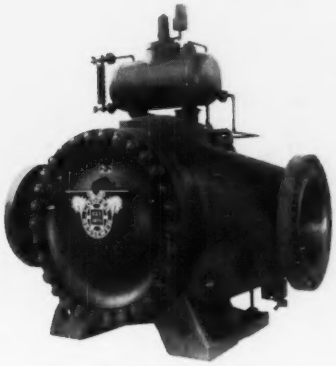
For more facts circle 216 on Reader Service Card, p 122



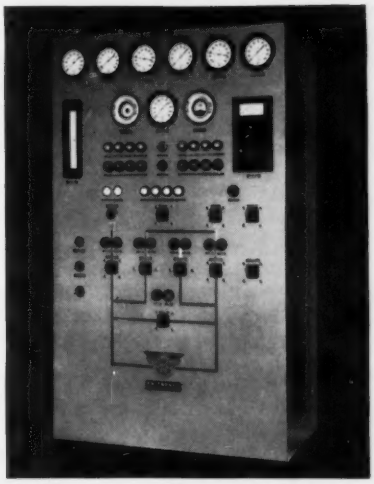
Horizontally split, process air or gas centrifugal compressor. Range: Up to 100,000 cfm.



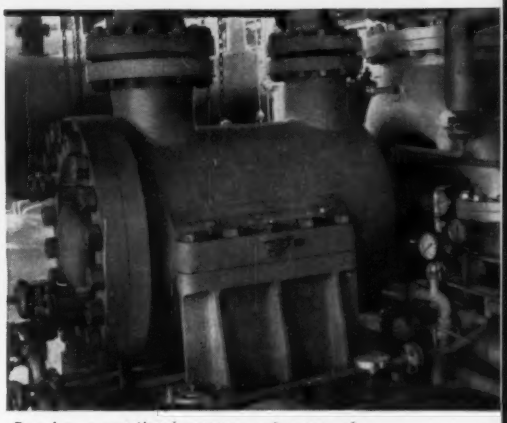
Horizontally split, intercooled centrifugal compressor designed for low cost shop and process air and gas. Up to 30,000 cfm.



Pipeline centrifugal booster with a history of record-breaking performance. Up to 20,000 bhp.



Installations can be integrated with Cooper-Bessemer En-Tronic Controls all the way from simple monitoring to complete system automation.



Barrel type centrifugal compressor for gas and air at pressures up to 5000 psi.

To get the most for your compressor dollars, it will pay you to check into Cooper-Bessemer Centrifugal Compressors because these fully-proved products offer you a combination of four outstanding advantages:

1. You get a design that's matched to your needs. A wide range of types and sizes of Cooper-Bessemer Centrifugal Compressors are available to assure optimum performance on *your* processing or air supply application.

2. You get unsurpassed quality. The designs include many field-proven distinctive features. Cooper-Bessemer's high standards of materials and craftsmanship are applied to every component of these precision-built units... to assure utmost reliability.

3. You can get undivided responsibility. We can engineer the entire compressor installation, including drive and controls. Cooper-Bessemer En-Tronic Controls are available to provide any degree of automation.

4. You get service for most profitable performance. Our outstanding field service and warehouse facilities assure prompt attention to your operating needs... with resulting reduction in your inventory and downtime.

Our nearest office will gladly supply complete information on Cooper-Bessemer Centrifugal Compressors to meet your needs exactly. Call them today.

BRANCH OFFICES: Grove City • New York • Chicago • Washington San Francisco • Los Angeles • Houston • Dallas • Odessa • Pampa Greggton • Seattle • Tulsa • St. Louis • Kansas City • Minneapolis New Orleans • Shreveport • Casper

SUBSIDIARIES: Cooper-Bessemer of Canada, Ltd.... Edmonton • Calgary Toronto • Halifax

Cooper-Bessemer International Corporation... New York • Caracas Mexico City

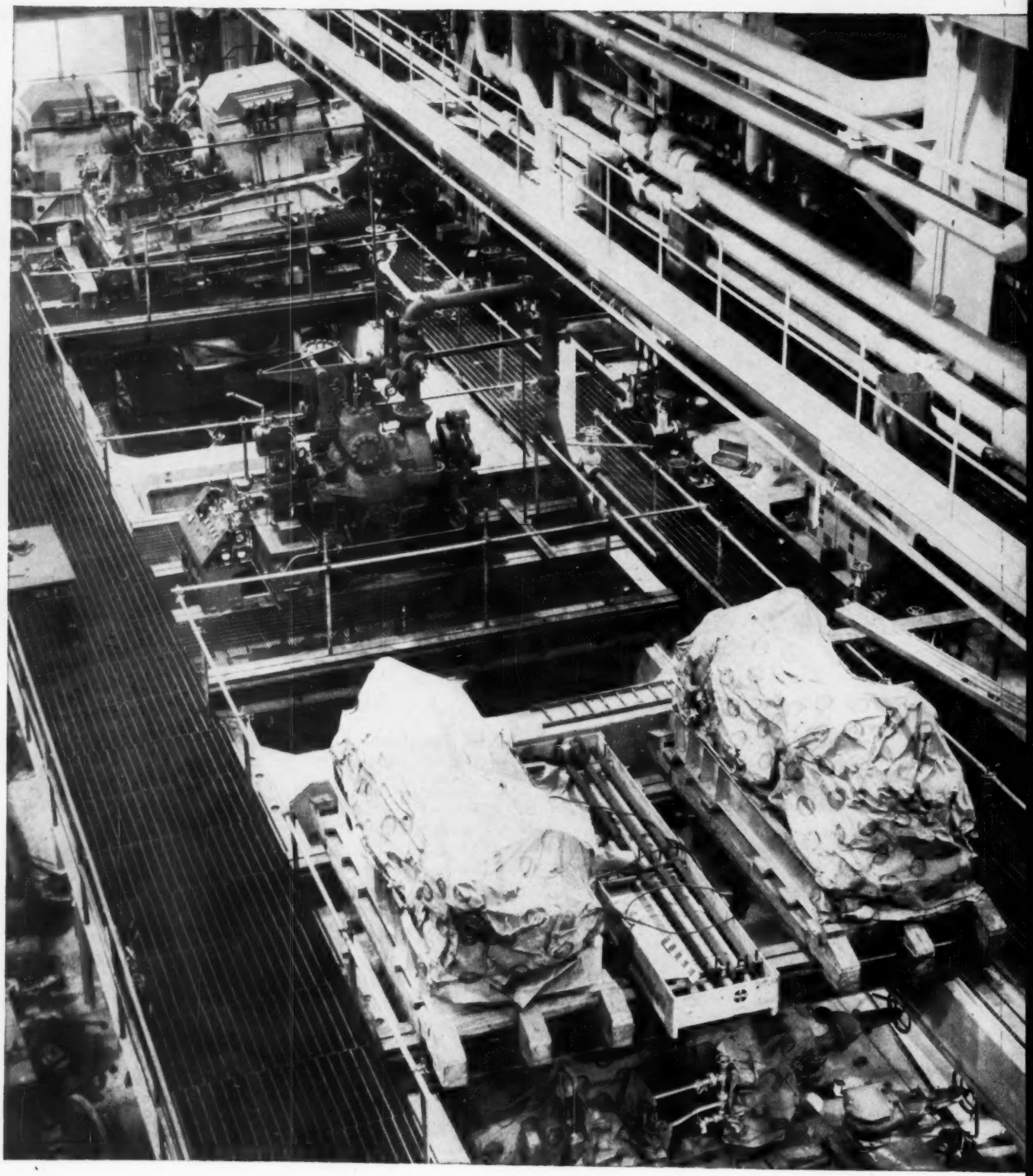
C-B Southern, Inc.... Houston

Cooper Bessemer

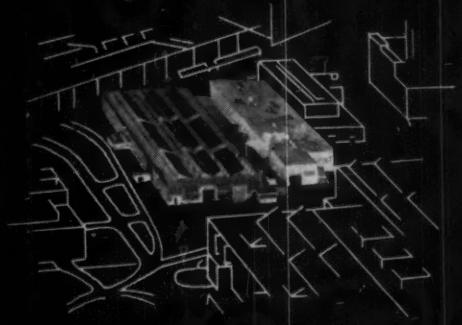
GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL, ENGINE OR MOTOR DRIVEN

New Small Turbine Plant at Westinghouse . . .



meets your exact power needs ... speeds deliveries



As part of the Westinghouse Steam Division, these completely self-contained small turbine facilities assure you of personal attention and service.

Left: Portion of the test facilities at new plant, showing (top to bottom) tilt test, boiler feed pump test and two units ready for shipment.

Here at the world's most modern small turbine facility, engineering, manufacturing and quality control are tailored to individual customer requirements.

Backed by extensive research and development, long-range planning and expansion of these facilities now bring you these major advantages . . .

*Exact power needs from the most complete product line in the industry** — Knowing that turbine users must consider both capacity needed and the economics of steam consumption, Westinghouse has developed the world's broadest line of small turbines.

Extensive quality control — Each turbine is thoroughly tested and proved before shipment to insure the highest efficiency and reliability. Checks are made at all critical stages of production by the most advanced testing equipment available.

Individual service and fast delivery — In these new small turbine facilities, entire production sections are devoted to single components, while new assembly aisle test stands offer the most advanced production techniques available for this type of manufacturing process.

While the specialized operations of the Small Turbine Department are completely self-contained to assure you of personal attention and service, the resources, facilities and experience of the entire Steam Division are available to insure technical precision in meeting your specifications.

Westinghouse small turbine representatives will be glad to discuss your needs with you at any time. Just call, write or wire your nearest Westinghouse Apparatus Sales Office or the Westinghouse Electric Corporation, Small Turbine Sales, Lester Branch Post Office, Philadelphia 13, Pa.

**Single-Stage Turbines* — *seven frame sizes available with horsepowers from 5 to 4000, speeds from 1000 to 12,500 rpm, for pumps, fans, compressors, blowers, paper machines and special Navy-designed pumps.*

Multi-Stage Turbines — five frame sizes available with speeds to 16,000 rpm and horsepowers to 50,000 for paper machine drives; power plant generation up to 5000 kw; high-speed special process compressor drives; boiler feed pump drives, operating under any heat balance cycle; turbine-generator units for shipboard service.

High-Speed Reduction Gears — twelve frames are available for most economical turbine speed selection in low-speed applications.

J-50602

YOU CAN BE SURE...IF IT'S

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

For more facts circle 217 on Reader Service Card, p 122

DECIDING ON AIRFOIL?

INSIST ON "BUFFALO"

Mechanical Efficiency up to a True 92%

MAXIMUM FORCED-DRAFT PERFORMANCE UNDER SPECIFIC CONDITIONS

WHEN YOU INSIST ON "BUFFALO" AIRFOIL FANS you immediately find many important factors in your favor. "Buffalo" Airfoils give you *true* mechanical efficiencies up to 92%. Main point here is that "Buffalo" Airfoil Fans will positively *live-up* to their ratings. They are designed, engineered, built and tested to deliver these peak efficiency ratings. You can *rely* on "Buffalo" Airfoils to meet your performance specifications.

There are sound engineering "reasons why" behind the proven performance of "Buffalo" Airfoil Fans. "Buffalo" offers unique, deep-blade airfoil design plus a brand new approach to streamlining. Turbulence is reduced to an absolute minimum because of the smooth inlet bell — the matching curved wheel flange — the new "Buffalo" divergent outlet. And with "Buffalo", you get more than an airfoil fan — you can choose from a *complete line* of airfoil and semi-airfoil wheels, to give you maximum efficiency for your precise operating conditions.

Whichever "Buffalo" Fan *you* select as best-suited to your operation . . . you're sure of getting the famous, rugged, dependable, long-lasting construction that's been an integral part of every "Buffalo" product for more than 80 years. We call it the "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

For the Finest in Mechanical Draft Service, Write Us now for Bulletins FD 106, FD 205, and F 200.

BUFFALO FORGE COMPANY
BUFFALO, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

For more facts circle 218 on Reader Service Card, p 122 For more facts circle 219 on Reader Service Card, p 122 >

TO MARK PROGRESS

LADISH

Controlled Quality

LIGHT WEIGHT WELDING FITTINGS

developed for economical, dependable low pressure piping systems

LOWER COST

Substantial savings realized in purchase price of fittings and pipe.

REDUCED WEIGHT

Important weight reductions achieved by reducing wall thickness to correspond with service requirements.

GREATER FLOW

Larger inside diameter provides increased flow capacity.

EASE OF INSTALLATION

Reduced weight facilitates handling . . . speeds installation.

AVAILABILITY

Stocked in sizes 4" through 24". Wall thicknesses range from .188" to .250".

CONFORMITY TO SPECIFICATIONS

These fittings meet all requirements of ASA Code for Pressure Piping B31.1 —1955 and B31.1.8—1955, ASTM A234 and ASA B16.9.

Lower purchase cost . . . reduction in weight . . . economy and ease in installation . . . increase in flow capacity—these are multiple advantages gained in using Ladish Light Weight Seamless Welding Fittings.

These Light Weight Fittings have been developed and produced under rigid metallurgical and manufacturing standards as part of a continuing program to meet the specific needs of industry for economical, functionally designed fittings.

Specification sheets on Light Weight Welding Fittings and Flanges available on request.

TO MARK PROGRESS

LADISH CO.

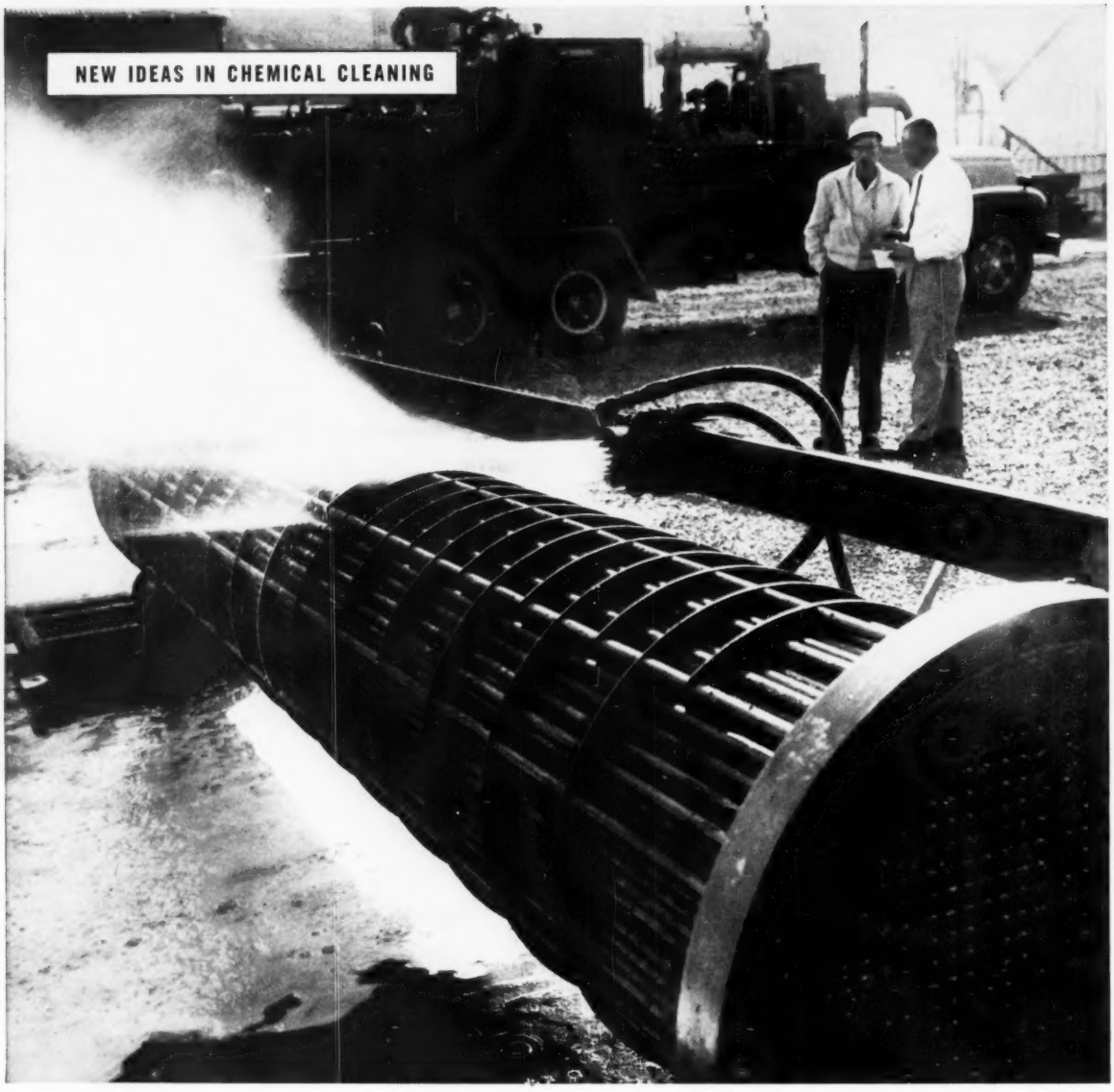
CUDAHY (Milwaukee Suburb) WISCONSIN

SALES OFFICES: Amarillo • Atlanta • Baton Rouge • Buffalo • Calgary Chicago • Cincinnati • Cleveland • Denver • Havana • Houston • Los Angeles Mexico City • Montreal • New York • Odessa • Philadelphia • Pittsburgh St. Louis • St. Paul • San Diego • San Francisco • Seattle • Toronto • Tulsa

SAW BLADES • PIPE FITTINGS • DROP FORGINGS • RINGS • VALVES

LADISH...THE FITTINGS LINE THAT OFFERS COMPLETE SERVICE IN TYPES, SIZES AND MATERIAL SPECIFICATIONS

WELDING FITTINGS	ASA & MSS FLANGES	SCREWED & SOCKET FITTINGS & UNIONS	LONG NECKS	LARGE DIAMETER & T.E.M.A. FLANGES



New Jetting Tool To Clean Tube Bundles Saves Thousands Of Dollars

The new high-pressure hydraulic tool, shown above, is currently saving thousands of dollars for companies in the refining, chemical, and petrochemical industries. It is the jetting tool developed by Dowell to remove deposits from heat exchanger tube bundles.

Previous methods of cleaning these bundles have been costly, time-consuming and often inadequate. Many times bundles had to be replaced completely because of the lack of a suitable cleaning method.

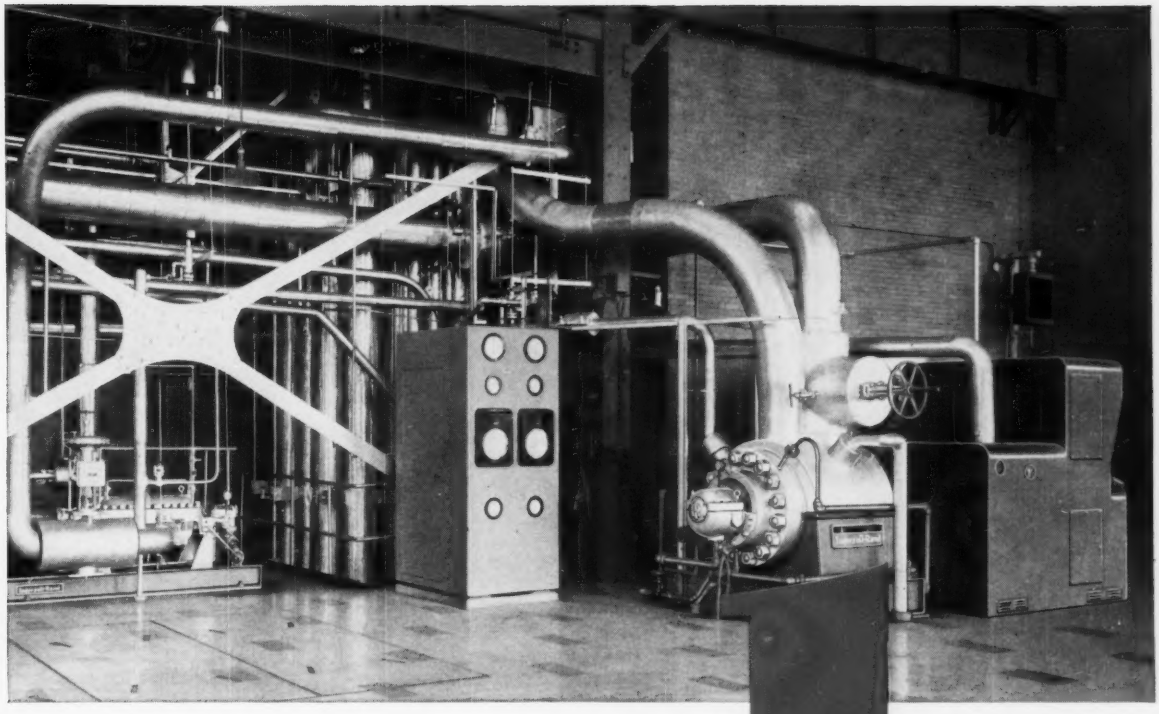
This new Dowell tool has a remarkable record of thorough, fast cleaning. For example, a slurry reboiler exchanger bundle, three feet in diameter and 16 feet long, was fouled with deposits of coke and asphalt. After being jetted from only one side, the bundle was thoroughly clean. Time required: less than one hour.

The tool holds the bundle in place for cleaning and has flanged rollers for rotation. The jet-head is manipulated automatically so that all tube spaces are covered. The jetted liquid can be either water or chemical solvents.

This high-velocity jetting device is another example of the new ideas Dowell continues to offer in chemical cleaning to help you cut your costs. Whatever the cleaning problem in your plant, call Dowell for an engineered recommendation. Dowell — the largest, the oldest, the most experienced chemical cleaning service — Tulsa 1, Oklahoma; and 165 stations and offices in major industrial centers.

Chemical cleaning service for all industry DOWELL
DIVISION OF THE DOW CHEMICAL COMPANY

For more facts circle 220 on Reader Service Card, p 122



FULL-CAPACITY PUMPS... ONE per boiler

I-R High-Speed Boiler-Feed Pump at Appalachian Power Company's Glen Lyn Station is the first of 8 Identical I-R Units installed on the American Electric Power System

The Ingersoll-Rand boiler-feed pump shown above represents a radical departure from previous central station practice. Instead of the usual three-pump arrangement with two normally carrying full load, in this installation one main pump supplies all the feedwater required for the 225 MW Glen Lyn Unit No. 6. This unit first operated in May 1957. The last of seven more I-R full capacity boiler-feed pumps like the one shown above is currently being installed.

In addition to making important savings in first cost and operating cost, the turbine-driven full-capacity pump improves cycle performance and heat balance conditions by using extraction steam from the main turbine to drive the pump and exhausting this steam to feedwater heaters.

Each pump, rated 1,500,000 lb/hr at 2400 psig and 5400 rpm, is driven directly by a General Electric turbine. Pumps are of 4-stage, double-case construction with "Unit-Type" rotor assembly and floating-ring type stuffing boxes. Boiler start-up is handled by a smaller auxiliary motor-driven I-R feed pump, barely visible in the left background above.

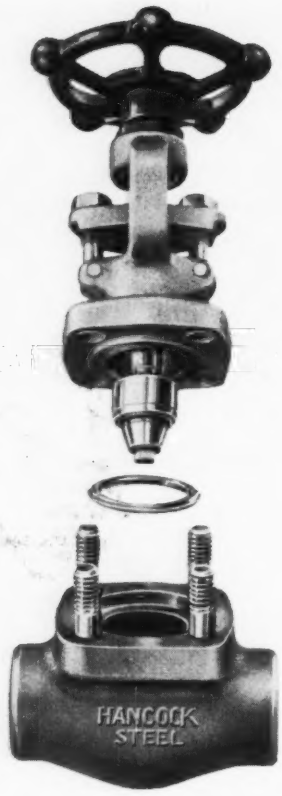
In addition, American Electric Power will soon put into operation the *world's largest* boiler-feed pumps—two 22,000 hp I-R full capacity units serving new 450 MW generators at two AEP stations.

For further details on full-capacity boiler-feed pumps, or any other boiler-feed units, contact your Ingersoll-Rand sales engineer.

Ingersoll-Rand

10-906 ♥ 11 Broadway, New York 4, N. Y.

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS
CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

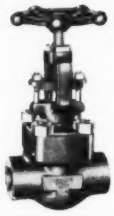


NEW VALVE-OLOGY

shuts off costly maintenance

Hancock 600# Steel Valves incorporate new concepts in valve-ology that reduce valve maintenance and equipment down-time. The forged steel bonnet and body have butting flanges so strong no distortion is possible. The flanges form a bonnet joint that utilizes the sealing power of a Flexitallic* gasket so effectively not even pressures exceeding ten times the rating of the valve can cause a blowout.

Hancock valve-ology makes full use of stainless steel to reduce your valving cost. Seat, disc, stem, swing bolts and nuts, thread bushing, packing gland follower—all are stainless steel. Globe, Angle, "Flocontrol", Lift Check, and Hi-Pressure Drop designs available. A high degree of standardization simplifies servicing and inventory needs. Your industrial supply distributor will gladly give you full details on Hancock Valve quality and performance. Phone him today.



Hancock 600# Steel Globe Valve. Type 5500 Line. Sizes: ¼" thru 2".

*Trademark of Flexitallic Gasket Company

MAXWELL MM& MOORE INC. MANNING TRADE MARK

HANCOCK STEEL VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

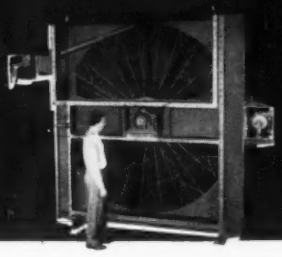
Consolidated Ashcroft Hancock Division • Watertown, Massachusetts
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more facts circle 222 on Reader Service Card, p 122

HERE'S WHAT YOU CAN DO ABOUT THE HIGH COST OF FUEL

GET MORE HEAT FROM EVERY FUEL DOLLAR WITH A

Ljungstrom® Package Air Preheater



By recovering heat from the exhaust gas, the Ljungstrom Air Preheater can increase combustion temperature as much as 400° or more! By raising furnace temperature this way, you permit more heat to be absorbed into boiler tubes or heat transfer surfaces. The results are increased capacity and greater output from every fuel dollar you spend.

And when you credit fuel savings, the installed cost of a Package Ljungstrom can be paid for in approximately two years.

You get maximum heat recovery because the Ljungstrom's exclusive rotary heat transfer element puts the heat back directly into the combustion air, i.e. without passing it through heat-absorbing partitions or tube walls. Package design also gives you all the advantages and economies of the Ljungstrom in a compact, pre-assembled unit. Available in vertical or horizontal models, Package Ljungstroms are readily adaptable to any plant arrangement.

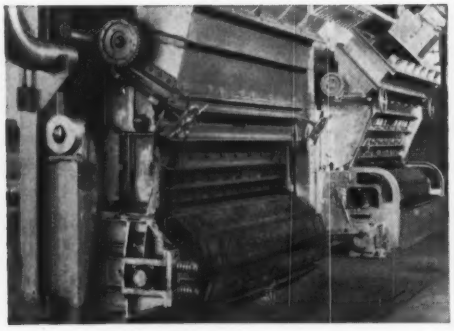
For further information, write today for the free 14-page Package Ljungstrom manual.

THE AIR PREHEATER CORPORATION

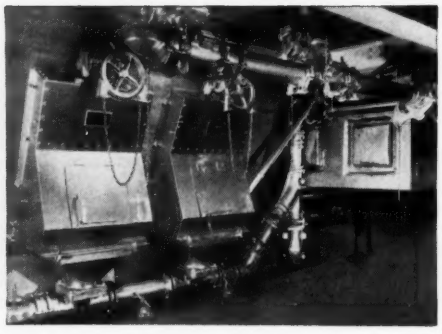
60 East 42nd Street, New York 17, N. Y.

For more facts circle 223 on Reader Service Card, p 122

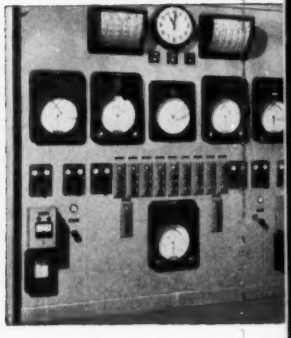
New 450 HP LW-80—world's largest coal hauler—is 12' high by 12' wide, 54½' long. It hauls 100 cubic yards (80 tons) per trip at speeds up to 34 mph.



View in the LeTourneau-Westinghouse boiler plant. In foreground is an Erie City 40,000 lb/hr type I.W.T. boiler, used on stand-by basis and for peak loads in very cold weather. At the right rear is Erie City 60,000 lb/hr main boiler. Both are fired by Combustion Engineering Inc. traveling grate stokers.



Shown are ash hoppers, part of United Conveyor ash handling system. Ashes are dumped from ash pits into hoppers from where they are piped pneumatically to silo. This system also handles dust from Prat-Daniel dust collectors.



Bailey Control Panel includes boiler meters & recorders, feedwater controllers and alarms, drum level recorders and alarms, gages for draft control.

From pit to plant, LeTourneau-Westinghouse moves with coal

Earthmoving equipment manufacturer estimates steam generated from coal costs only half as much as from competitive fuels

At LeTourneau-Westinghouse Co., Peoria, Ill., steam is used to heat an area that has swelled to a million square feet of space. Increasing demand created the need for a modern boiler plant to replace obsolete equipment. When plans were drawn for the new plant, fuel surveys indicated that the firm should continue to use coal for availability and economy. Estimates showed that steam produced from burning coal in this area costs about *half as much* as from competitive fuels.

Today LeTourneau-Westinghouse has found that burning coal in modern equipment cuts costs in several ways. Fuel costs, of course, are at a minimum. Automatic, efficient operation has lowered coal and ash handling costs. And manpower requirements have been reduced from 12 to 7 men.

Coal is lowest cost fuel

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% more steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

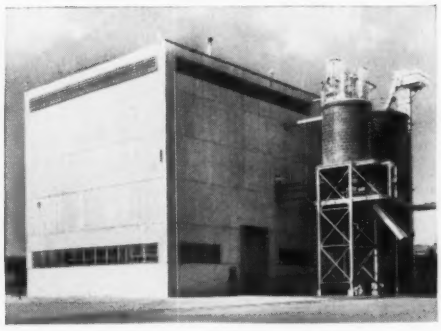
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

BITUMINOUS COAL INSTITUTE

Department P-03, Southern Building, Washington 5, D. C.

See our listing in *Sweet's*



New heating plant showing 9000 cu. ft. Kalamazoo Tank & Silo Co. coal silo (on right). Coal moves by conveyor from track hopper to top of silo. Entire coal handling system by Beaumont Birch Co. To left of coal silo is Kalamazoo 25-ton ash silo equipped with United Conveyor dustless rotary unloader.

SEND COUPON FOR NEW BCI PUBLICATIONS. Guide Specifications, with complete equipment criteria and boiler room plans:

Bituminous Coal Institute, Southern Building, Washington 5, D. C.

Gentlemen: Please send me: **P-03**

☐ GS-1 (low-pressure heating plant, screw-type underfeed stoker); ☐ GS-2 (high-pressure heating and/or process plant, ram-type underfeed stoker); ☐ GS-3 (automatic package boiler for heating and process plants). ☐ Case histories on larger plants.

Name _____

Title _____

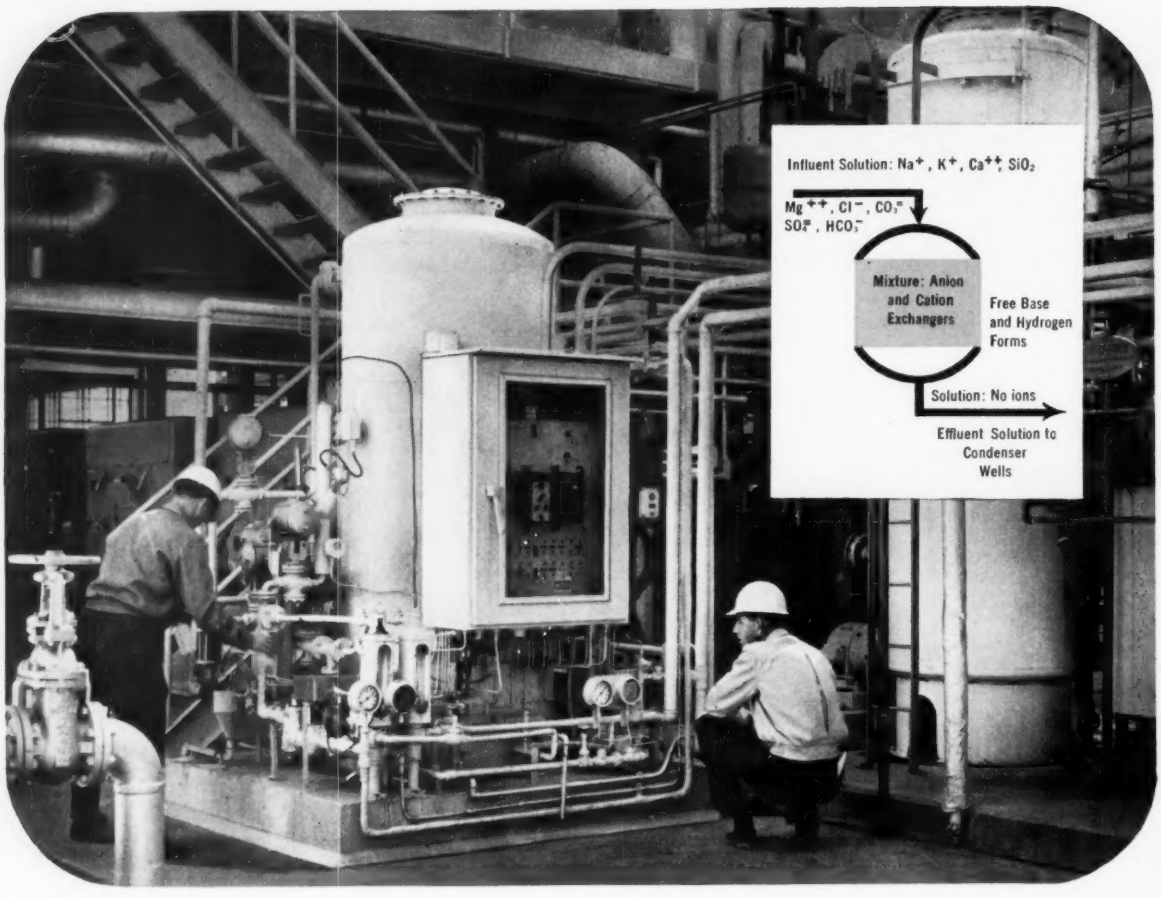
Company _____

Address _____

City _____ Zone ____ State _____

For more facts circle 224 on Reader Service Card, p 122

ION EXCHANGE RESINS protect ultra-modern power plant


Influent Solution: Na^+, K^+, Ca^{++}, SiO_2
Mg^{++}, Cl^-, $CO_3^=$
$SO_4^=$, HCO_3^-
Mixture: Anion and Cation Exchangers
Free Base and Hydrogen Forms
Solution: No ions
Effluent Solution to Condenser Wells

Low 0.001 ppm Silica Content of AMBERLITE-Treated Water Keeps Powerplant Turbines Clean as New for Five Full Years

A continuous supply of water with a silica content of 0.001 ppm and below has practically eliminated causes of maintenance downtime on boiler and turbines at Louisiana Power & Light Company, Ninemile Point steam electric generating station near Westwego, Louisiana.

When a turbine was opened for the first time in five years of operation, all blading was completely clean. There were no signs whatever of deposits. No boiler or superheater tubes have been lost and iron oxide deposits on tubes are described as "very low".

Using a MONOBED mixed bed of AMBERLITE IR-120 cation exchange resin and AMBERLITE IRA-401 anion exchange resin, LP&L supplies water with less than 0.1 ppm total solids content to generating equipment at its ultra-modern Ninemile Point Steam Electric Station. The unit is rated at 14,600 gallons with an influent of 380-mmho and effluent quality averaging 0.4 mmho.

LP&L reports results are better than an evaporator would give with the same water supply. The pH runs approximately 6.8 to 7.0.

Regeneration of the MONOBED unit is completely automatic. A master timer regulates the process. Control is much closer than would be possible under manual operation, resulting in substantial saving of chemicals and water.

In any ion exchange system, effluent quality is dependent upon not only influent composition but upon unit design and operating technique. Consult your engineering company experienced in water treatment for full information on how AMBERLITE ion exchange resins may help to solve your needs for deionized, softened, dealkalized or deacidified water. Write for your copy of our booklet "If You Use Water".

AMBERLITE and MONOBED are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.

Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

For more facts circle 225 on Reader Service Card, p 122

Reliance Boiler Safety for 75 Years

There has always been danger from low water in boilers — even at 50 lbs. pressure! Accidents — *boiler explosions* — did happen back in the days when pressures over 50 psi were considered "high".

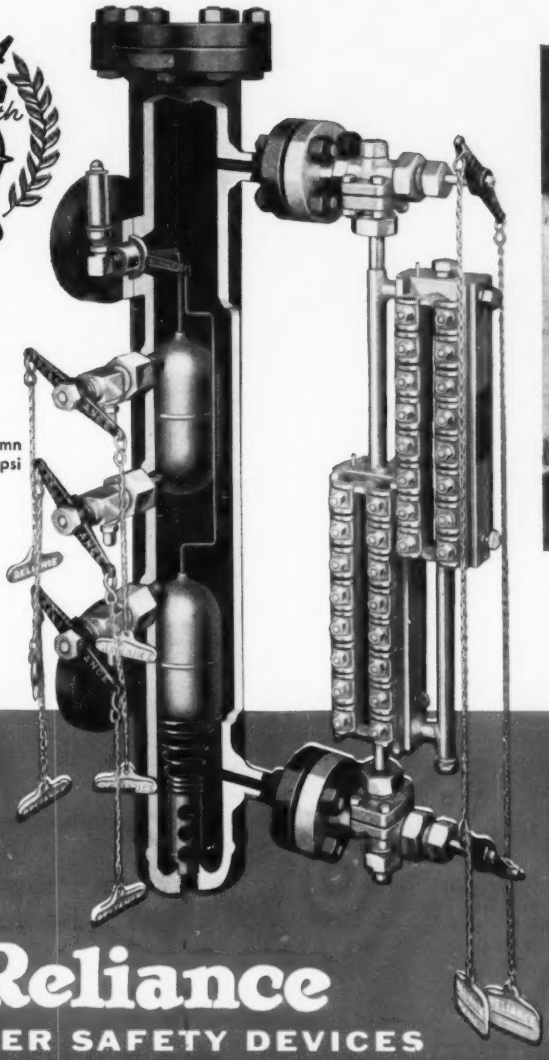
So the Alarm Water Column was invented by a man who recognized the need, and in 1884 Reliance introduced the forerunner of water columns used today in thousands of power plants.

Reliance has kept abreast of the steady rise in working steam pressures with appropriate designs in water columns, with and without alarms. Necessary items for column "trim" — try cocks, gage valves and gage inserts, (also direct-to-drum assemblies) gage illumination, and auxiliary alarms and indicators are offered in various types to suit all needs.

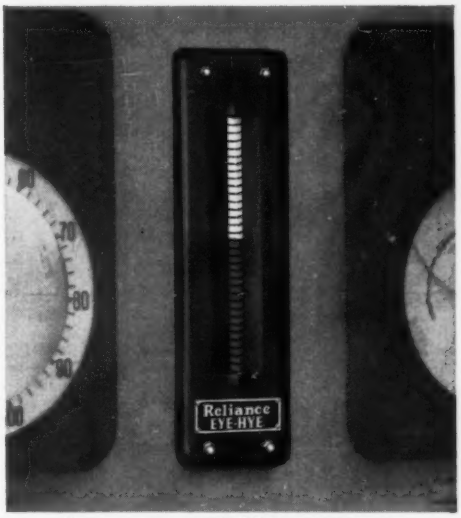
Reliance produced the first compensated remote reading boiler gage in America. The EYE-HYE now serves as an extra safety factor for many thousands of boilers, both stationary and marine. More recently, Reliance electrode-type devices have made it possible to actuate alarms, fuel cutouts, and start and stop pumps on any pressure.

The *originator* of safety water columns, Reliance has been the only manufacturer devoted exclusively to the measurement of boiler water levels for the past 75 years . . . Reliance engineer representatives are located in all principal cities.

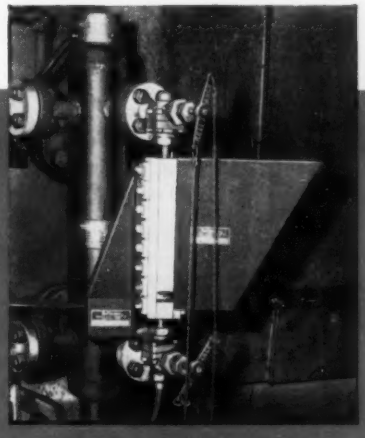
1884 75th YEAR 1959



Typical Water Column for pressures to 900 psi



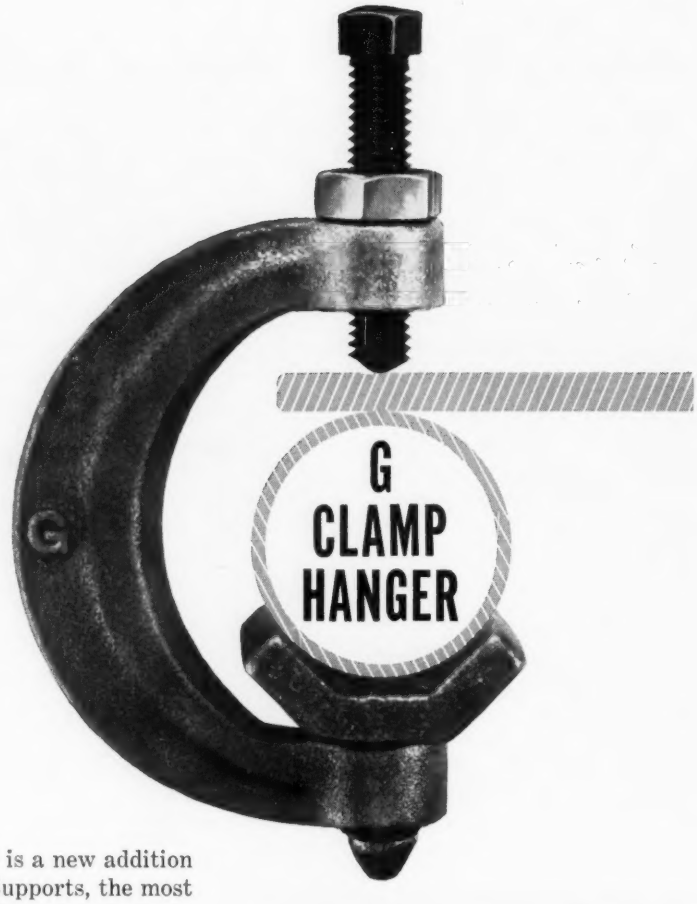
Above — newly styled EYE-HYE remote gage readable up to 90° either side of center.



Reliance
BOILER SAFETY DEVICES
The Reliance Gauge Column Company, Cleveland 3, Ohio

For more facts circle 226 on Reader Service Card, p 122

New addition to the line of Grinnell malleable iron hangers



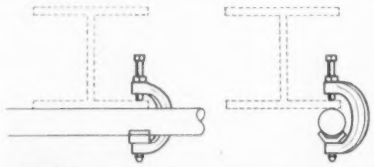
Grinnell's Malleable Iron G Clamp Hanger is a new addition to the line of Grinnell Pipe Hangers and Supports, the most complete line of any manufacturer. This hanger answers a long-felt need for support of pipe or conduit (up to 4 inches in size) where application can be made directly under structural steel.

The saddle of the Grinnell G Clamp swivels. This permits pipe or conduit to be installed either parallel or traverse to the beam axis. Separate beam clamp, rod and pipe clamp are not required, thus saving cost of supports and installation time.

Grinnell G Clamps are made of malleable iron with a ribbed design for added strength. The set screw has a hardened steel cup point for clamping rigidly to beam. Full thread engagement is provided by the tapping through the upper jaw. Approved by Factory Mutual Laboratories for use on fire protection and plumbing systems. Especially recommended for hanging conduit. Maximum recommended loads are from 210 to 450 pounds, for the smallest to the largest sizes, with a safety factor of 5.

Every Grinnell Malleable Iron Hanger offers . . .

- Safety factor of at least 5
- Thickness of metal increased at points of concentrated stress
- Homogenous metal composition throughout
- Extremely high resistance to impact and corrosion
- Economy



Saddle swivels, permitting suspension of the pipe or conduit at any angle in a plane parallel to the face of the supporting flange.

GRINNELL
AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPLIERS

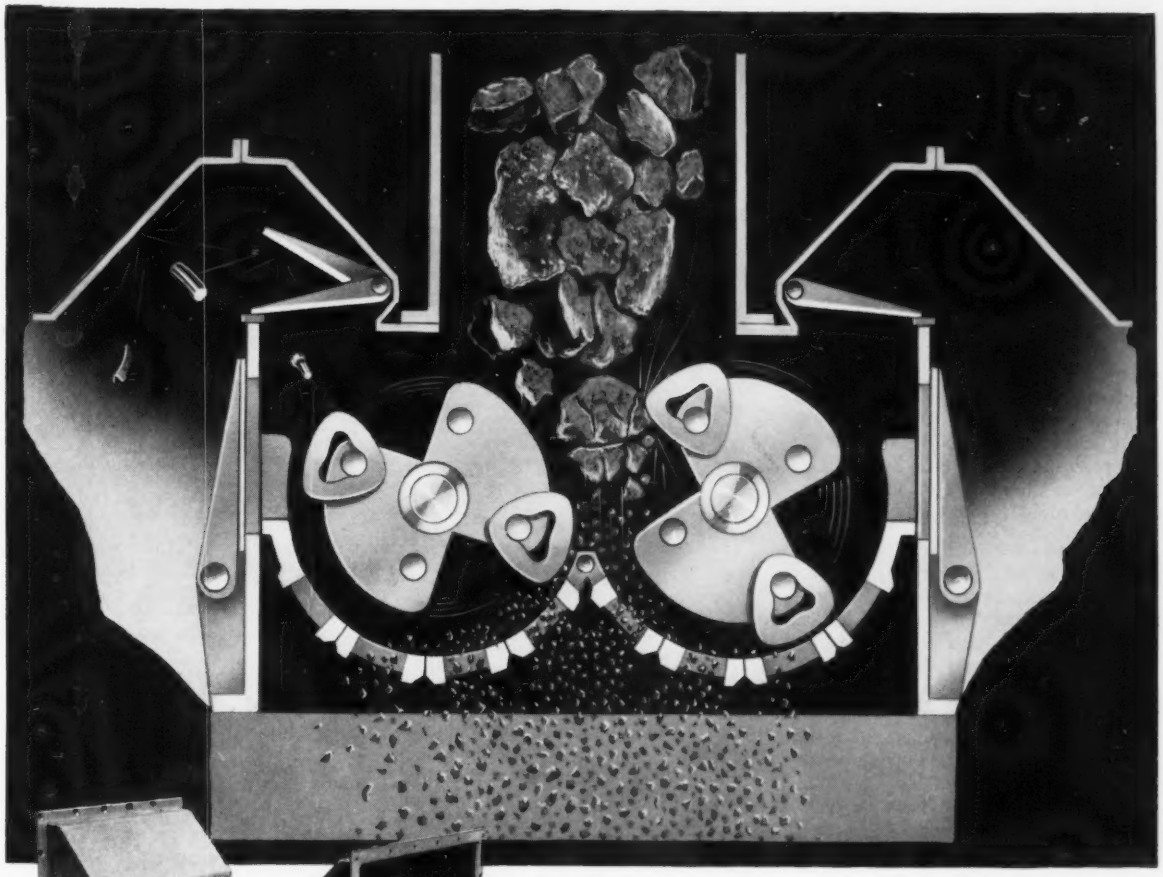
Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

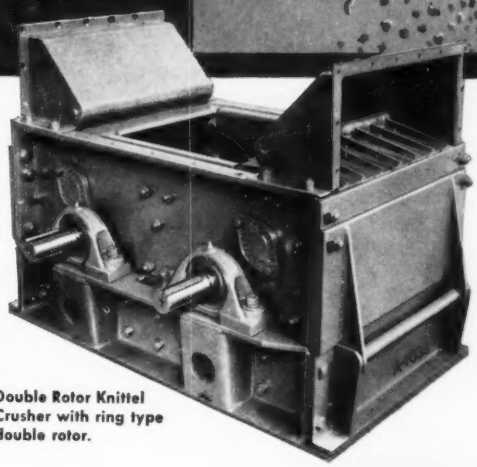
pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

For more facts circle 227 on Reader Service Card, p 122

STEPHENS-ADAMSON

KNITTEL CRUSHER Ring Type with Double Rotor





Double Rotor Knittel Crusher with ring type double rotor.

DOUBLE ROTORS BLAST LUMPS TO SIZE WITHOUT DANGER OF PLUGGING

- EXCLUSIVE CRUSHING ACTION . . . Permits the material to fall further into the crusher where two sets of triangular sectors can take a high velocity direct blow on the suspended lumps. Lumps are not only shattered but are literally gobbled up in a continuous flowing stream to the sizing grates.
- CRUSHES DAMP MATERIALS with FULL CAPACITY . . . Eliminates the use of stationary breaker plates, as a result there is no plugging or choking and full capacity is maintained.
- LESS HEADROOM — LESS POWER REQUIRED . . . Requiring considerably less headroom and less power than with single rotor machines.
- TRIANGULAR SECTORS . . . Three wearing surfaces of manganese steel triangular sectors automatically position themselves to present the least worn surface to the crushing action.
- GRATE SIZING BARS . . . Provide accurate sizing of materials, prevent uncrushable materials from passing.
- AUTOMATIC TRAMP IRON RELEASE . . . Steel fingers, operating independently, automatically lift to pass uncrushable material.

WRITE FOR BULLETIN 858

S-A

ENGINEERED BULK HANDLING SYSTEMS
STANDARD MATERIALS HANDLING PRODUCTS
SPEEDWALK® PASSENGER CONVEYORS
TRAMASTER® BALL BEARING UNITS
SPHERICO® BEARINGS & ROD ENDS

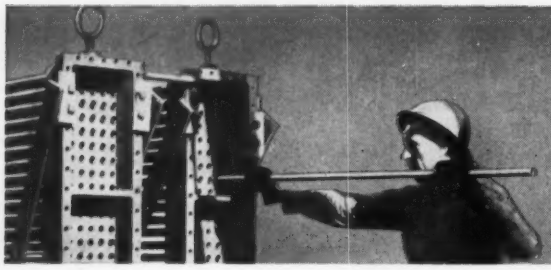
ENGINEERING DIVISION

STEPHENS-ADAMSON MFG. CO.

GENERAL OFFICE & MAIN PLANT, 5 RIDGEWAY AVENUE, AURORA, ILLINOIS

PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
BELLEVILLE, ONTARIO

For more facts circle 228 on Reader Service Card, p 122



CONDENSER AND HEAT EXCHANGER CLINIC

Edited by David S. Hibbard, Metallurgical Engineer
The American Brass Company, Waterbury 20, Conn.

The trend is to longer, small-diameter heat exchangers in high-pressure, high-temperature systems

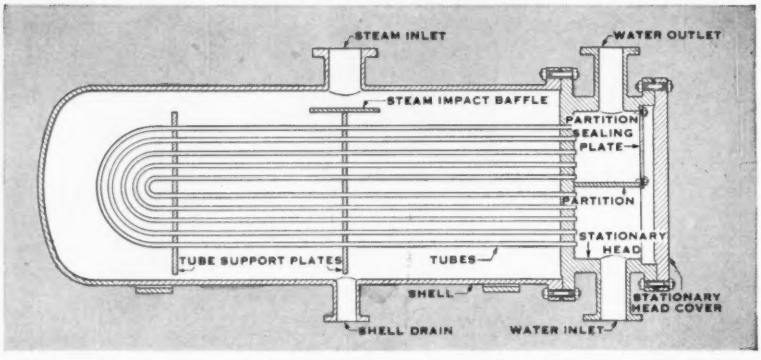
Where relatively high pressures are involved—as in power station feed-water heaters and many exchangers for oil refineries, chemical, and petro-chemical plants—it is very costly to get increased capacity by increasing shell diameters beyond about 48″.

It is more economical to lengthen the equipment. And this means longer tubes—either as straight lengths with a floating head or as U-bend tubes.

U-bend Tube Design of exchangers has several inherent advantages, particularly when wide temperature differences exist in the unit. Each U-bend tube individually takes care of its expansion stresses. The number of rolled tube joints is cut in half. The absence of a floating head eliminates one gasketed joint and reduces the total weight of the tube bundle, making handling easier.

The average length of tubes involved is already beginning to crowd the heretofore standard maximum of 60 feet. And The American Brass Company, recognizing the trend to still greater length, has installed new mill equipment to produce tubes up to 100 ft. in straight lengths—in U-bends with the length of the straight leg up to 50 feet. The radius of the bend to the center line can be as small as 1½ times the outside diameter of the tube, or as great as 30 inches.

Dual-gage Tubes. For the tubes with short-radius bends in the middle of the bundle, provision should be made for extra metal at the bend to prevent thinning of the tube wall below a safe minimum for the service. Dual-gage tubes are made with extra wall thickness in the area of the bends. This cuts cost and weight, as the extra metal is only at the bends where it is needed and not down the entire length of the tube. Cost savings have been estimated at from a few cents to several dollars a tube, depending on the alloy used. The American Brass Company makes dual-gage tubes one BWG thickness heavier in the bend area.



Schematic drawing of U-bend-tube-design feed-water heater. *Courtesy The Griscom-Russell Co.*

Annealing. Both single-gage and dual-gage tubes are annealed at the bend to relieve stresses developed in the bending process, which otherwise might lead to stress-corrosion cracking.

Testing. Tube quality is particularly critical in high-pressure, high-temperature service. Furthermore, U-bend bundles are so tightly packed that it is difficult to remove a defective tube, particularly at the center. So The American Brass Company has added equipment to make hydrostatic tests up to 6000 psi on even the longest U-bend tubes after they have been bent. Air tests up to 250 psi with tube submerged in water can be made on straight lengths up to 60 feet.

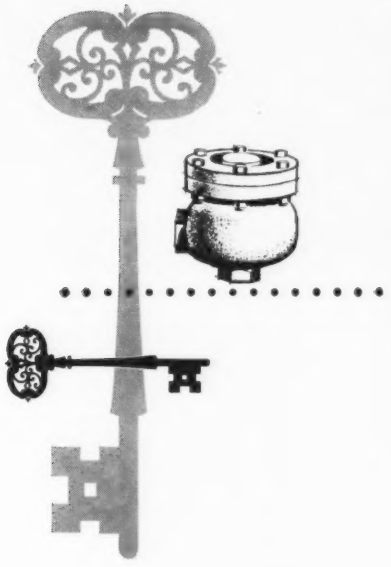
Technical Assistance. For more detailed information on extra-long tubes, U-bend, Dual-gage, or Duplex tubes to meet special problems, address: The American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Limited, New Toronto, Ont. 5876

Compact tube bundle for a feed-water heater using U-bend tubes averaging 45′ long. Similar units have been made with tubes up to 85′ long.

ANACONDA®
TUBES AND PLATES FOR
CONDENSERS and HEAT EXCHANGERS
Made by
THE AMERICAN BRASS COMPANY

For more facts circle 229 on Reader Service Card, p 122

Who Holds the Key in Turnkey?



Not the consulting engineer.

Not the prime contractor.

Not the subcontractors.

Not even the customer's representative who, assigned to build a plant and stay within the building budget, is too often willing to forfeit the future for a good cost showing today.

The key to this plant's productivity and profits is held solely by the *owners*.

The owners must, of necessity, think in terms of how much this plant will produce, and at what cost. They must, of necessity, think of *total cost*.

Total cost includes the price of original equipment, the expense of installing it, and how much it costs to maintain it over the entire useful life of the plant.

Take steam traps, for example. Lots of traps cost less than Nicholson's. In a box on the jobber's shelf, that is.

But when the plant *owners* have paid the cost of installation, and "dry, clean steam" has been contaminated by everything from weld bead to broken beer bottles and the *owners* have paid the cost of that, and finally when the "bargain" traps have broken down in service—the *owners* call on Nicholson.

Quality Nicholson steam traps, sometimes higher in initial cost but always lower in installed cost, have long enjoyed the reputation of being the *owners'* favorite—the favorite of the people who, in the long run, have to pay the bill. ST-100

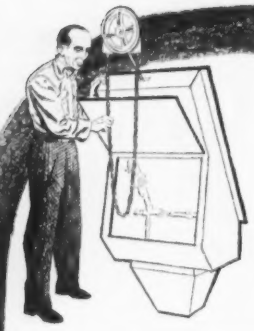
NICHOLSON

OF WILKES-BARRE

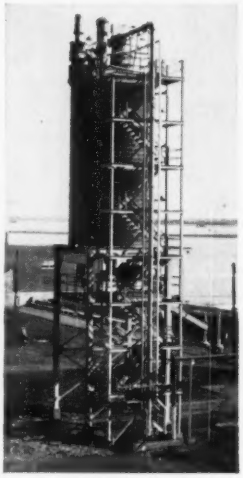
W. H. Nicholson and Co. • 10 Oregon Street • Wilkes-Barre, Pa.

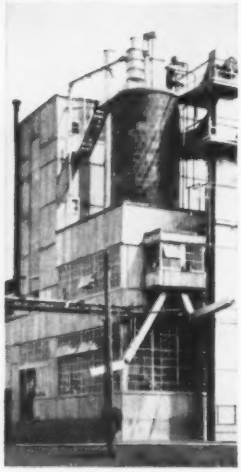
Distributors in all principal cities

For more facts circle 230 on Reader Service Card, p 122

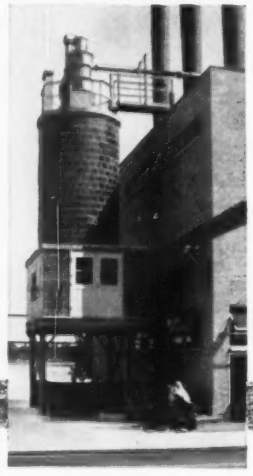


100 ton Ash Silo straddling R.R. track with full stairway to roof. High capacity Ash Conditioner on open platform with discharge to R. cars.





Ash Silo constructed integrally with boiler house. Ash Conditioner mounted inside building. Bifurcated chute allows R.R. car or truck loading.



Ash Silo for truck loading with enclosed room for ash conditioner.

American Cyanamid Co.
American Gas & Electric Service Corp.
American Sugar Refining Co.
Calvert Distillers
Carrier Corp.
Central State Hospital of Virginia
Chemstrand Corp.
Chicago Pneumatic Tool Co.
Cluett-Peabody Co., Inc.
E. I. DuPont
Ford Motor Co.
General Foods Corp.
General Motors Corp.
Glidden Co.
B. F. Goodrich Company
Grumman Aircraft
H. J. Heinz Co.
Hoover Company
Indiana University
Kelsey-Hayes Wheel Company
John A. Manning Paper Co.
Marion Power Shovel Co.
Mergenthaler Linotype Co.
National Distillers
Charles Pfizer Co.
Pittsburgh Plate Glass Co.
Public Service Electric & Gas Co.
Ravenna Arsenal
Riegel Paper Corp.
Rohm & Haas Co.
Square D Company
Stauffer Chemical Corp.
U. S. Steel Corp.
Universal Atlas Cement
University of Missouri
Villanova College
Wake Forest College

These fine organizations, and hundreds like them, choose National for

ASH REMOVAL AT LOWER COST

Interested in Ash Conveying equipment? Ask your nearest *National* representative to show you, without obligation on your part, how costs can be cut with a National Steam-operated Pneumatic, Hydraulic or Motor-driven System. National offers a nation-wide installation service – high operating efficiency – rugged, wear-resistant pipe and fittings that provide lower maintenance cost per ton of ash conveyed. Consult National now – one contract covers everything, from inception to finished installation. Write us, or nearest representative listed below.

SEND FOR FREE BULLETINS

Bulletin P57-A
on pneumatic ash conveyors

Bulletin H57
on hydraulic ash conveyors

National CONVEYORS COMPANY INC.
FAIRVIEW, BERGEN COUNTY, N. J.
WHitney 5-9136

Also manufacturers of: **National ChipVeyor Systems** for the collection and processing of metal chips and borings and reclamation of cutting oils (Send for Bulletin C-56). **Conveyors** for press scrap and small parts and **Pneumatic Systems** for handling dry granular materials (Bulletin P-58G).

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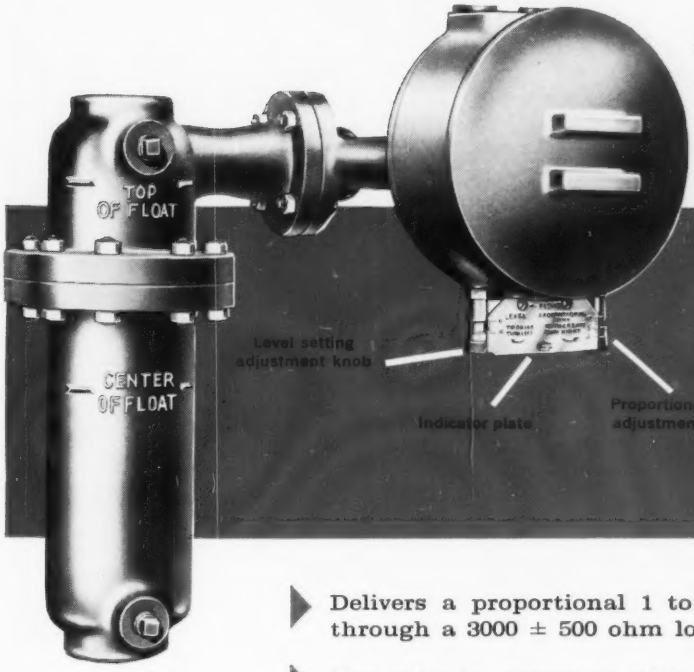
ATLANTA 3, Ga. — P. H. Nichols & Co. — 400 Whitehead Bldg. • **BALTIMORE 18, Md.** — Lamb Engineering Co. — 2125 Maryland Ave. • **BOSTON 94, Mass.** — Mills Engineering Co., Inc. — 300 First Ave., Needham Hts. • **BUFFALO 2, N. Y.** — Charles P. Hague, Inc. — 625 Delaware Ave., Rm. 202 • **CHARLOTTE 7, N. C.** — E. I. Mountcastle — 2617 Selwyn Ave. • **CHICAGO 4, Ill.** — Burke & Colston (Ash) — 53 W. Jackson Blvd. • **CHICAGO 5, Ill.** — Mayer & Oswald (Chip) — 407 S. Dearborn St. • **CINCINNATI 27, Ohio** — Smith E. Hughes — 3716 Petoskey Ave. • **CLEVELAND (Lakewood 7), Ohio** — J. Harry Haywood — 12031 Edgewater Dr. • **DETROIT (Ferndale 20), Mich.** — Beltaire-Drissen — 570 Livernois Ave. • **HARTFORD, Conn.** — Dee Engineering Co. — Cromwell, Conn. • **HOUSTON 5, Texas** — Industrial Handling Engineers — 1200 Bissonnet • **KANSAS CITY 12, Mo.** — W. C. Carolan Inc. — 612 W. 47th St. • **LOS ANGELES 13, Calif.** — W. F. Huff and Co. — 417 S. Hill St. • **PHILADELPHIA, Pa.** — C. V. McQuary — P.O. Box 52, Cheltenham, Pa. • **PITTSBURGH 29, Pa.** — Gibson & Stanier Engineered Products — P.O. Box 9742 • **ST. LOUIS 22, Mo.** — Medor, Inc. — 10408 Manchester Ave.

NOW FISHER LEVEL-TROL®

FOR ELECTRONIC SYSTEMS

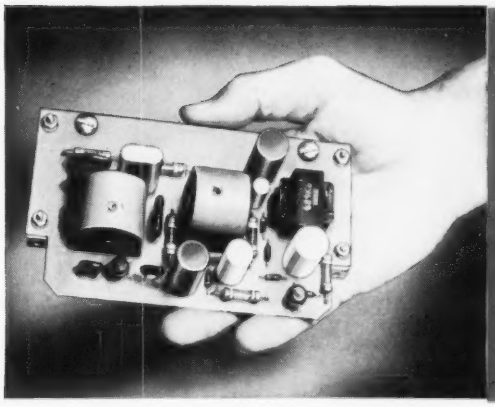


Quick accurate external adjustment

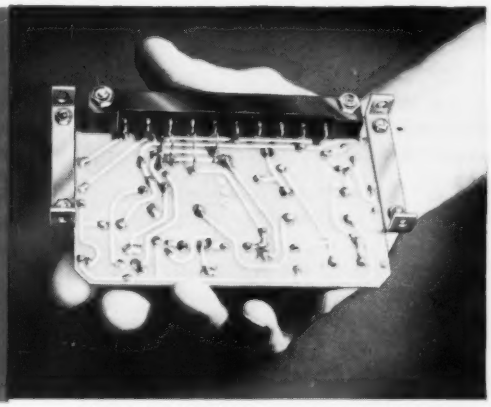
- **Delivers a proportional 1 to 5 milliampere dc signal through a 3000 ± 500 ohm load.**
- **Has plug-in converter with printed circuit. Conventional leads and unnecessary wiring are eliminated.**

This Fisher explosion-proof Electronic Level-Trol features external adjustment for proportional band and liquid level height, and incorporates extreme simplicity of design throughout. Silicon transistors and diodes are used instead of the conventional vacuum tubes. You do not need any additional parts to reverse action of the unit. With only .25% effect from ±15% supply voltage change, line voltage fluctuation is of negligible effect.

Fisher Bulletin F-85 will give you complete details on the Fisher Type 2300 Electronic Level-Trol. Send for it.



Plug-in electronic converter assembly.



Printed circuit of the converter assembly.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

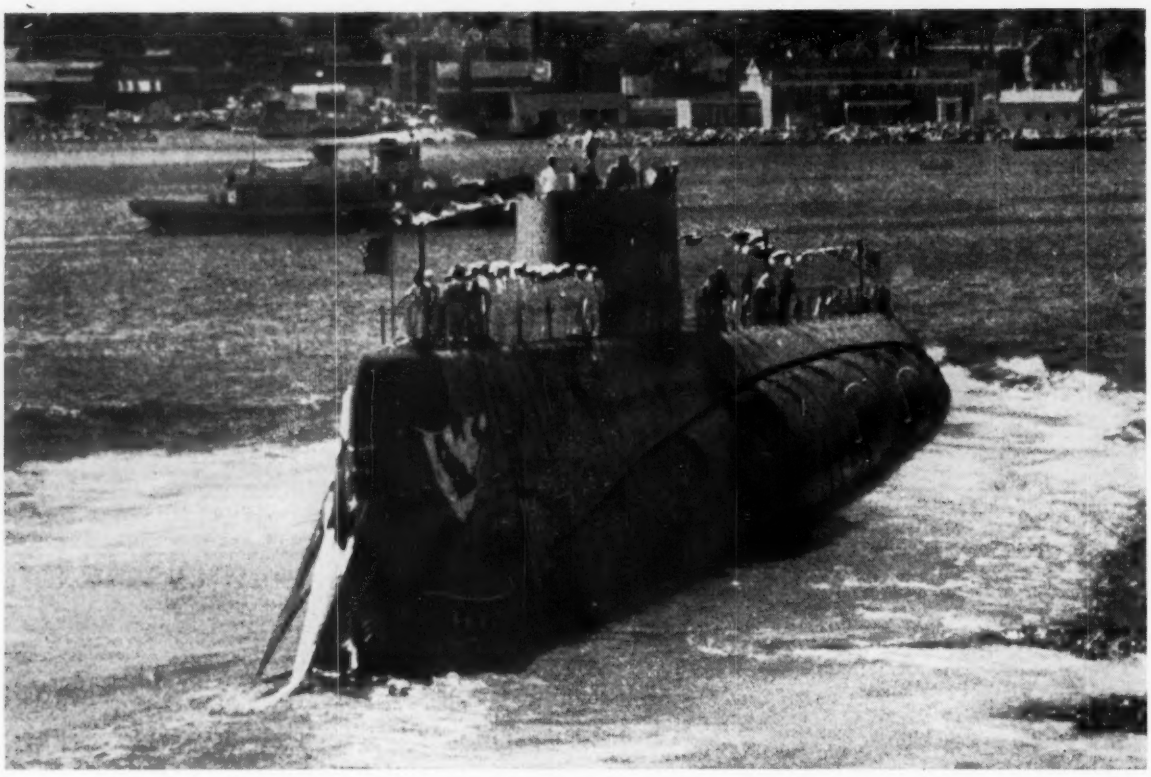
Marshalltown, Iowa Woodstock, Ontario London, England

CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Pennsylvania

FISHER® Controls

SINCE 1880

For more facts circle 232 on Reader Service Card, p 122



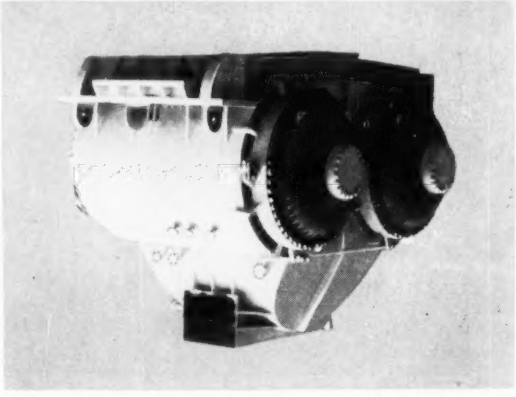
Triton, Navy's Largest Nuclear Sub, Uses Bridgeport Condenser Tubes

Launched in August, 1958, the U.S.S. *Triton* is the biggest, most powerful submarine ever built. With a length of 447 ft. and a displacement of 5,900 tons, *Triton* boasts, among other things, of two engine rooms and two reactor compartments. Built by the Electric Boat Division of General Dynamics Corporation, she is truly a major achievement in naval architecture.

Naturally, *Triton's* equipment must meet the most rigid operating requirements. Helping to fulfill these requirements are Bridgeport Cupro-Nickel condenser tubes in the Allis-Chalmers condenser and air ejector equipment.

Meeting operating demands such as *Triton's* has long been standard practice at Bridgeport. Outstanding operating records have been—and are being—achieved regularly. The experience and knowledge gained from these records can be put to your use—whenever you wish to take advantage of them.

Whatever your needs—simple retubing or other requirements—they are best served, in every respect, by Bridgeport. If you have any problem, question or plans involving heat exchanger equipment, on land or at sea, call your nearest Bridgeport Sales Office. For full details, write direct for the 162-page Bridgeport Condenser Tube Handbook. Write Department 5403.



These twin condenser units were designed and built by Allis-Chalmers. Bridgeport tubes were used throughout.

Bridgeport Brass Co.

BRIDGEPORT BRASS COMPANY

Bridgeport 2, Connecticut • Sales Offices in Principal Cities

Specialists in Metals from **A***luminum to* **Z***irconium*

For more facts circle 233 on Reader Service Card, p 122

The Power Plant Engineer Said: "I WOULDN'T KNOW..."

INQUIRING REPORTER: So you use Nalco System water treatment ... How often are your boilers turbined? *

ENGINEER: I wouldn't know—only worked here seven years.

* You recognize the Engineer's answer as a twist on the old one about *How-often-do-you-get-a-raise-around-here.* Our excuse for bringing it up is that the engineer's answer applies to hundreds of plants using Nalco water treatment. New plants, starting boilers from scratch with Nalco, report years on line, *billions* of pounds of steam generated in boilers that have *never* been turbined ... and probably never will be. Older plants, where turbining was as routine as checking the draft gauges, now open boilers only to show the inspectors.

These Nalco *results* can quite possibly be duplicated in your plant, regardless of the kind or severity of your water treatment problems ... or the size of your operation. Write or phone, now, for a fast start toward permanent water treatment security.

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago 38, Illinois

Telephone: POrtsmouth 7-7240

In Canada: Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM ... Serving Industry through Practical Applied Science

Nalco CHEMICALS

For more facts circle 234 on Reader Service Card, p 122

The MARSH way is the SURE way–

You'll have a new conception of how *uniformly good* radiator valves, traps and vents can perform when you make the job Marsh all the way through.

Take the Radiator Valve and Trap illustrated here, for instance:

The Marsh Radiator Valve is *truly* packless—not just *called* packless. This valve has no "packing" whatever... instead, the ingenious Marsh annular mechanical seal that keeps it drip tight throughout its far longer life.

And Marsh Radiator Traps are equally sure-footed... have the famous Marsh Diaphragm—extremely rugged, but so sensitive that it never fails to close tight on steam, yet opens instantly to pass condensate and air at only a few degrees below closing temperature.

Yes, the Marsh way is the sure way... Valves, Traps, Vents, F & T Traps, designed, built and tested to give lasting satisfaction in the Marsh tradition. Ask for up-to-date Heating Specialties Catalog 76-H.

MARSH HEATING EQUIPMENT CO.
Sales Affiliate of Jas. P. Marsh Corporation
Dept. F, Skokie, Illinois
Marsh Instrument & Valve Co., (Canada) Ltd.
8407 103rd St., Edmonton, Alberta, Canada

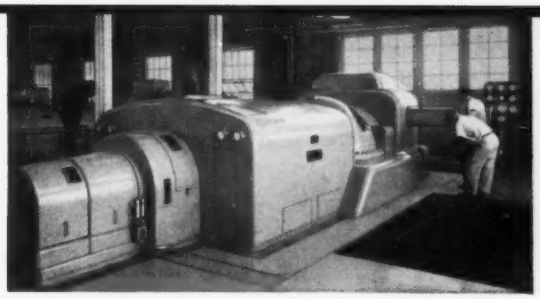
MARSH *Heating Specialties*
SINCE 1865

For more facts circle 235 on Reader Service Card, p 122

For more facts circle 236 on Reader Service Card, p 122 ➤

One reason why Fairfield, Illinois has efficient electric service-

Nonpareil Turbine Oil



Plant superintendent James Easton and Standard Oil industrial lubrication specialist Charlie Brown inspect 5,000 kw. Worthington turbine, one of four turbines in Fairfield Municipal Light & Power Company plant lubricated with NONPAREIL Turbine Oil.

These turbine installations trace the record of growth in electric power consumption in Fairfield, Illinois, over the past 19 years:

Type	Turbine Cap.	Installed
Westinghouse	1,500 kw.	March, 1940
Westinghouse	2,500 kw.	March, 1942
Westinghouse	4,000 kw.	March, 1949
Worthington	5,000 kw.	July, 1957

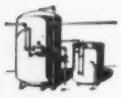
When the first turbine went into service, Fairfield Power plant management decided upon a turbine lubricant they felt would be dependable—NONPAREIL Turbine Oil. Standard Oil, they found, would give them concrete evidence of the oil's dependability. They received a certificate guaranteeing that, for the life of the turbine, the acidity of the oil would never exceed 0.15 mg. KOH/g. Indeed, through the years the oil has remained at a much lower acidity level, usually in the order of 0.06 mg. KOH/g. Periodic analysis of the oil in Standard's Whiting laboratory confirms that the oil is performing according to guarantee.

The kind of service Fairfield Municipal Light & Power gets from NONPAREIL Turbine Oil comes about this way: NONPAREIL is the subject of special refining techniques and handling. A special crude is used as a base stock. All sludge-forming compounds are removed. An oxidation inhibitor which permanently controls acidity is added. No sweetening or resting of NONPAREIL Turbine Oil is required at any time.

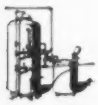
Men with experience in turbine lubrication can give you more facts about NONPAREIL Turbine Oil. Call your nearby Standard Oil office in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from **STANDARD** *and you get it!*

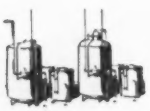
Standard's Charlie Brown, here with Easton, supervised installation of NONPAREIL Turbine Oil in Worthington turbine. His experience and training qualify him for such work. Charlie received science training and graduated from Eastern Illinois State College. He has nine years' service with Standard Oil and has completed Standard's Sales Engineering School.



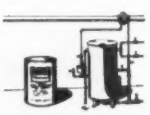
ZEOLITE WATER SOFTENER — manual and automatic. Up to 44% more soft water output from a softener of given size.



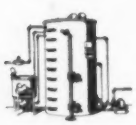
ULTRA-DEIONIZERS — produce highest quality mineral-free water. Replace distillation methods at fraction of distillation cost.



DEALKALIZATION & ION EXCHANGE SYSTEMS—Dealkalizers to control alkalinity. Ion Exchangers to produce water of any desired quality.

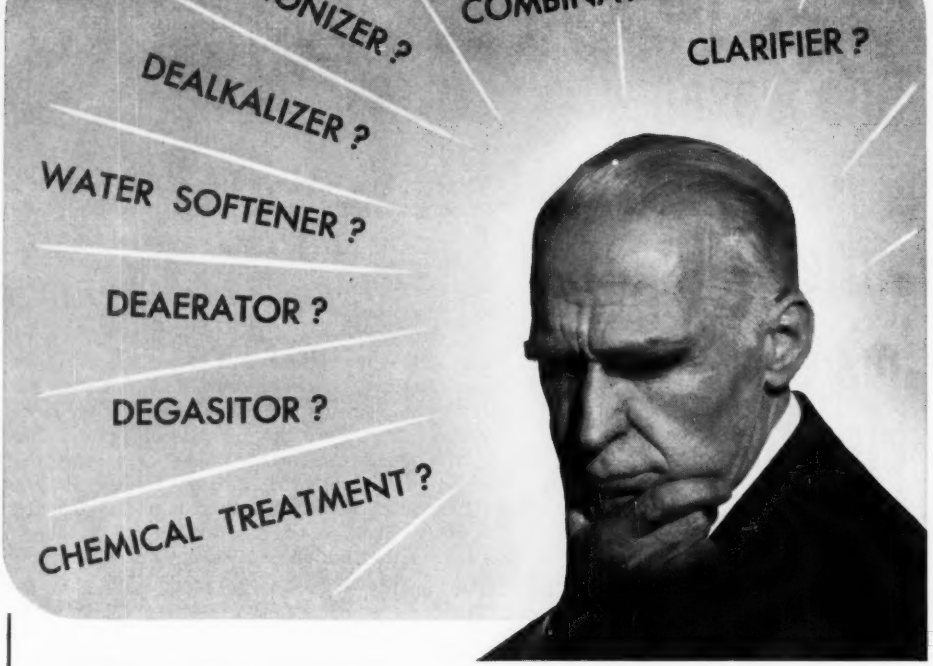


CHEMICAL TREATMENT SYSTEMS—prevent scale, corrosion and depositions with Elgin specially formulated chemicals.



CLARIFIER—for removing excess alkalinity and solids for clarification of turbid waters.

DEGASITORS—for removal of entrained gases from water by aeration.



Confused about your water problem?

It isn't surprising that you should be confused about your water conditioning problem when you think about the almost endless ways of solving it that are being thrown at you from all directions in these fast moving times.

But instead of being confused, you should be happy that there *are* so many new roads open! Actually the confusion arises from the many new developments in water conditioning that have been crowded into recent years. And this is all to the good . . . for it means that today you can find a far, far better answer to your water problem.

Yes, your only basic problem is to sort out the one best way of meeting your particular needs from all the ways and means available today. This is the all important problem, but we have the answer to that one too: Simply take your set of conditions to a firm like Elgin—an organization that for more than fifty years has travelled all the roads of water conditioning—opened many of them. Out of Elgin experience will come the best, the most economical solution to your problem.

NEW 24 page bulletin now on the press

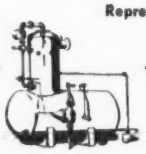
The up-to-date facts about Elgin equipment and service (briefly high-lighted here) will soon be ready for you in a new bulletin. It shows how Elgin experience—made available to you through your local Elgin representative—can give you the one best answer to your water conditioning needs.

Put yourself on the list to receive it!

ELGIN SOFTENER CORPORATION

130 No. Grove Avenue, Elgin, Illinois

Representatives in Principal Cities *In Canada: G. F. Sterne & Sons Ltd., Brantford*



DEAERATING HEATERS—supply make-up water pre-heated by exhaust steam in which CO_2 and oxygen are eliminated.

WATER FILTERS—Diatomite, sand, anthrafilt, activated carbon and oil removal filters in all types and sizes.

For more facts circle 237 on Reader Service Card, p 122

O-B VALVES

every part gives longer service

Part-for-part, O-B union bonnet gate valves are made to give the longest, most reliable service.

Handwheels are cast of tough aluminum alloy to withstand the strongest grip.

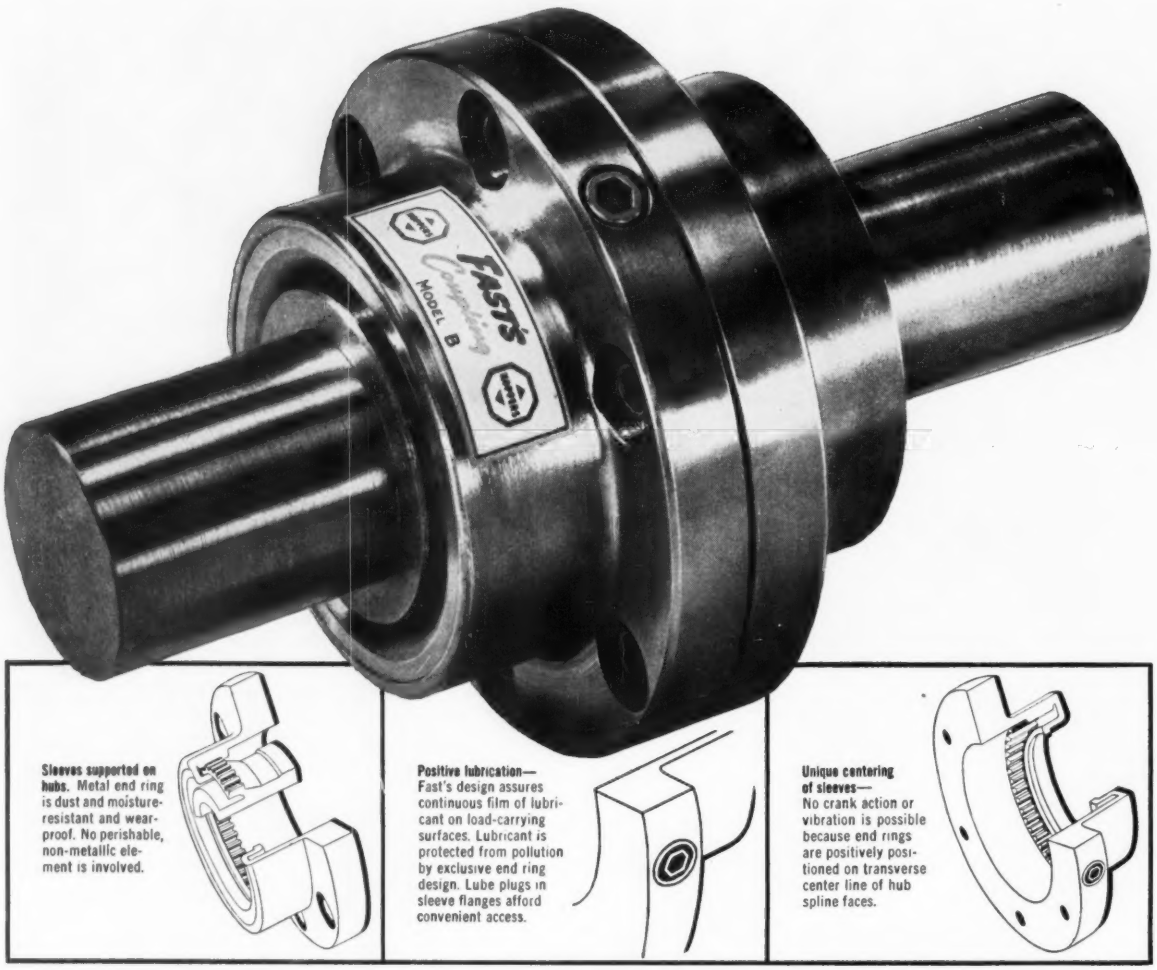
Stems and discs are cast or machined from a special copper base, high tensile, high yield strength bronze developed for excellent resistance to corrosion.

Bonnets, union rings, bodies and other cast parts are made of bronze 85-5-5-5 (ASTM B61) with plenty of weight for durable service.

Because of the care Ohio Brass takes in the manufacture of individual parts, valves last longer and need less maintenance.

O-B rising stem union bonnet gate valves are available in sizes from ¼-through 3-inches in pressure ratings of 125 lbs. WSP - 200 lbs. WOG and 150 lbs. WSP - 300 lbs. WOG. Ask your distributor about all O-B bronze valves, or write to Ohio Brass Company, Mansfield, Ohio.

For more facts circle 238 on Reader Service Card, p 122



Sleeves supported on hubs. Metal end ring is dust and moisture-resistant and wear-proof. No perishable, non-metallic element is involved.

Positive lubrication— Fast's design assures continuous film of lubricant on load-carrying surfaces. Lubricant is protected from pollution by exclusive end ring design. Lube plugs in sleeve flanges afford convenient access.

Unique centering of sleeves— No crank action or vibration is possible because end rings are positively positioned on transverse center line of hub spline faces.

Fast's Model B coupling reduces downtime and upkeep for light-to-medium drives

Mechanical flexibility eliminates costly shutdowns and expensive shaft replacements. But—it's only one of many cost-saving features.

Now you can profit from the durability and economy of famous Fast's couplings in a smaller and lower-cost version—available in 5 sizes for shafts ½" to 3⅛" in diameter.

The Model B coupling gives you the same features that have made Fast's the world's leading coupling for over 35 years. You get the same trouble-free performance, longer service life and lower maintenance costs. You also get prompt delivery because stocks are on hand to meet practically every need. Free engineering service is also available.

Write today for more details to KOPPERS COMPANY, INC., Fast's Coupling Dept., 5303 Scott Street, Baltimore 3, Md.

Engineered Products
Sold with *Service*

KOPPERS

THE ORIGINAL
FAST'S Couplings

For more facts circle 239 on Reader Service Card, p 122

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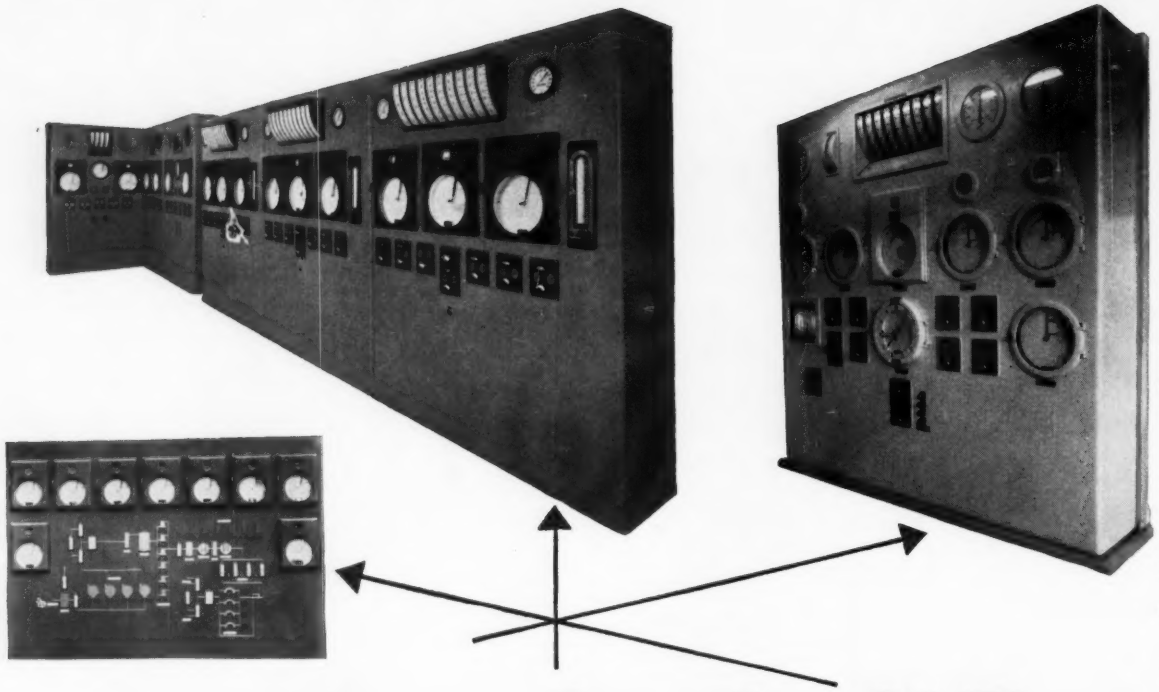

Base Any Of These

ON THIS

For accurate, efficient, dependable control systems— REPUBLIC'S NEW TYPE "VC" PNEUMATIC CONTROLLER

Here is an all purpose null-balance-vector controller for use with any pneumatic transmitter. Its proportional band ranges from 2% to 500% *without changing parts*, for quick adaptation to changes in process requirements. Especially important in high-precision control, Republic's Type VC has exceptional sensitivity and a narrow dead band (less than 0.05%). Its high capacity non-bleed pneumatic amplifier consumes little air, keeps output ample. A selector block permits reverse or direct action; local or remote pneumatic set point optional.

Companion instruments—using an identical null-balance-vector "heart"—include differential pressure, temperature and pressure transmitters . . . ratio, totalizing, multiplying, squaring and square - root - extracting relays. Many parts are interchangeable among the instruments in this "family". Besides reducing spare parts inventory, the similarity of components simplifies the task of training personnel.

Let a Republic engineer show you how these instruments can help to achieve accurate, efficient, dependable control systems. Republic Sales Offices are located in principal cities throughout the U.S.A. and Canada.

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FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
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Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.

LOUIS N ROWLEY, EDITOR • MARCH 1959 • ESTABLISHED 1882 Power

You asked for it!

That headline above probably has a familiar look —you saw it only two months ago on the January editorial. The repetition is deliberate. In January, I told you about some changes in POWER designed to make it even more useful and readable. Now, in March, I'd like to tell you about another step in our continuous effort to deliver the best possible engineering editorial service.

In the January issue, the "structure" of POWER was reorganized to put broad-interest departments in the middle of the magazine, between the Design and Equipment Application section up front and the Plant Maintenance and Management section in the back. And, most important, we've arranged *all* editorial material so reading is consecutive, without "continued" lines. One delighted reader has already dubbed POWER the "no skip" magazine.

Another January feature was the introduction of newly designed Reader Service Cards. By means of these cards you can now secure additional information on any new product described in *Plant Equipment News* and can send for any of the numerous free bulletins and catalogs reviewed in each issue. You can also readily obtain free data on any product and service advertised in POWER. And you can do all this with a minimum of trouble and without expense—the new Reader Service Cards require no postage; you simply circle key numbers and mail.

At the time I told you about these advances in your magazine, I had hoped to be able to initiate another often-requested improvement — perforated pages. But when January rolled around our printer had not quite finished installing and testing the special equipment needed to perforate the pages of a complete issue.

Now we are geared to do this perforating job throughout the entire magazine rather than on just a few pages as in the past—the *TD* reports and the *Data Sheet*, for example.

As a result of this forward step you will be able to remove any page, easily and neatly. This will facilitate filing articles for further reference, will make it easier to route articles to interested associates, will simplify attaching new-product pages and advertisements to memos and reports recommending plant improvements. These are just a few of the ways perforated pages will make POWER an even more useful, workable tool.

On the "Comment" line of the new Reader Service Card, and in your letters, you have told us that the improvements made in January are vastly to your liking, so we hope you will feel the same way about the perforated pages and will tell us so.

It's a good feeling to see this trusted mark on your

STAINLESS STEEL VALVES *too*

JENKINS®

Jenkins Bros

PATTERNS AND ALLOYS TO SATISFY MOST INDUSTRIAL NEEDS

For solid reasons, men who ask for the best in Stainless Steel Valves have full confidence when they see the Jenkins Diamond. For almost a century this mark has appeared only on valves made to peak standards of quality in design . . . in castings . . . in machining. JENKINS standards, enforced by the most rigid inspection and testing in the valve industry.

Valves of corrosion resistant stainless steels have been made to those high standards by Jenkins for a quarter of a century. And today, the line of Jenkins Stainless Steel valves includes types and alloys to fully satisfy most service requirements.

They are available through the same leading distributors everywhere who sell Jenkins Valves of Bronze, Iron and Cast Steel. Jenkins Bros., 100 Park Avenue, New York 17, N. Y.

NEW JENKINS
STAINLESS STEEL
VALVE CATALOG
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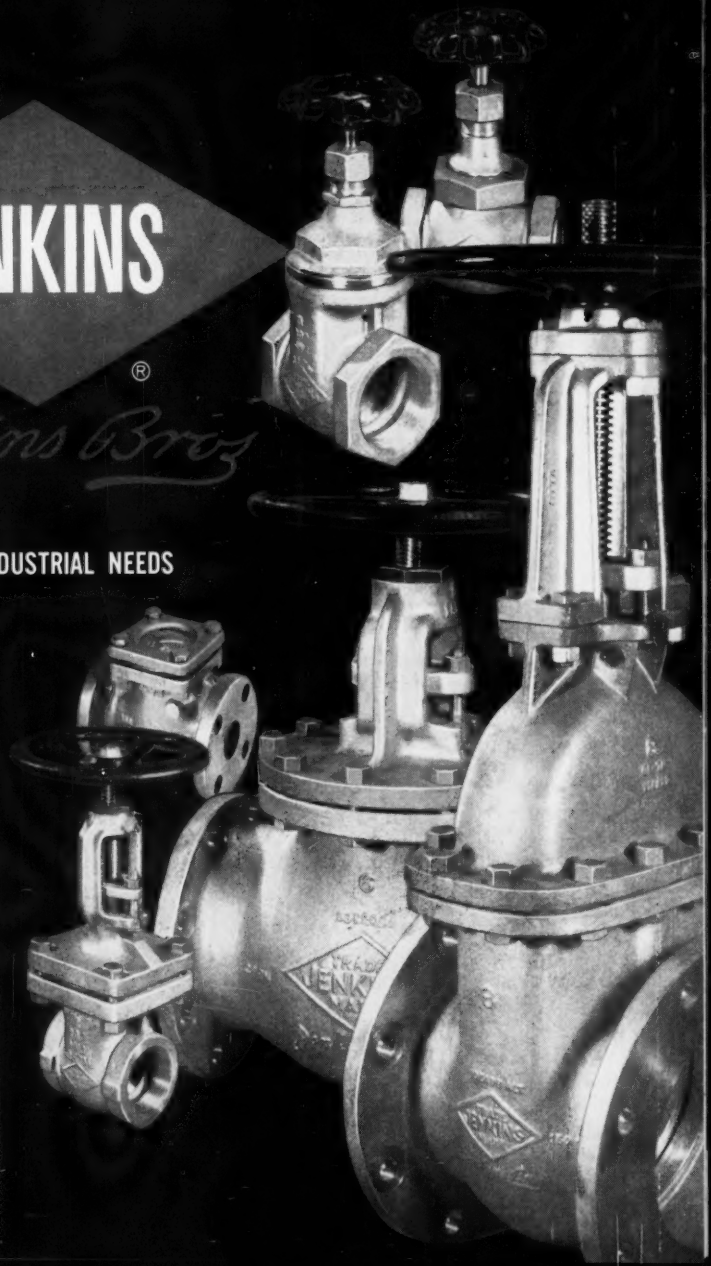


A **Y Globe** that challenges comparison shows it pays to

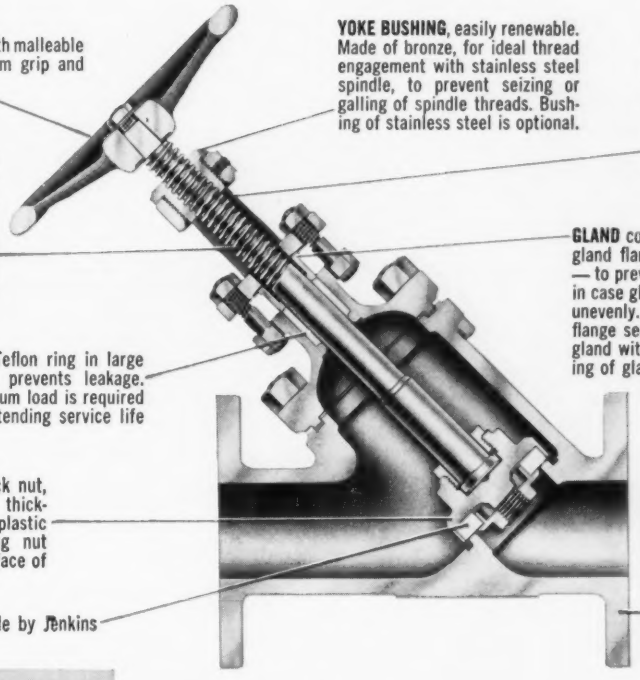
Specify JENKINS for STAINLESS STEEL Valves, too

Want the "best buy" in Stainless Steel Y Globe Valves? Compare this Jenkins Fig. 1335 with any on the market. You'll conclude that it's hard to beat Jenkins at making valves, no matter what the material.

You'll find genuine superiority of design and construction in the features shown here. But no picture can show the quality of the castings . . . the precision machining . . . the rigid inspection and testing that have gone into this valve. All of these are as important as design and metal alloys in assuring long, dependable, economical valve service. And, all of them are up to the peak standards for which Jenkins has been known for almost a century.

SEND FOR NEW CATALOG of Jenkins Stainless Steel Valves, in patterns and alloys that satisfy the requirements of practically all corrosive services.

These Jenkins Valves meet valve industry specifications and the high standards established by leading users of stainless steel valves.



WHEEL of high strength malleable iron designed for firm grip and easy operation.

SPINDLE of large diameter and dense structure has high resistance to wear and torsion strains. Easy, tight closing is assured by long, precision machined thread bearing surfaces. A beveled shoulder provides backseating against inside of bonnet, permitting repacking under pressure.

PACKING A Teflon ring in large packing box prevents leakage. Only a minimum load is required on gland, extending service life of packing.

DISC HOLDER, held by lock nut, has depth equal to disc thickness, preventing flow of plastic disc. Wide disc retaining nut covers all but seating surface of Teflon disc.

DISC is Teflon made by Jenkins

YOKE BUSHING, easily renewable. Made of bronze, for ideal thread engagement with stainless steel spindle, to prevent seizing or galling of spindle threads. Bushing of stainless steel is optional.

YOKE BONNET, a single unit, has liberal space between yoke arms for easy access to packing box. Tongue and groove joint with body makes a pressure-tight seal with less tightening on the bolts, and eliminates possibility of blowing out the Teflon gasket.

GLAND consists of two pieces — gland flange and gland follower — to prevent binding of follower in case gland bolts are tightened unevenly. Crowned surface of flange secures tightness against gland without excessive tightening of gland nuts.

BODY Through-port design for full, free flow. Liberal seat height permits repeated refacing. Cast on body are directional arrow and bosses for drain connections. End flanges conform to M.S.S. specifications.

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LOOK FOR THE JENKINS DIAMOND
VALVES

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For more facts circle 242 on Reader Service Card, p 122

ALL IN A DAY'S WORK at *Pittsburgh Piping*

STAINLESS STEEL AUTOCLAVE and VOLUTE
Shop Fabricated

by *Pittsburgh Piping*

This autoclave and volute assembly is typical of the work that goes through Pittsburgh Piping shops. Fabricated of Type 304 Stainless Steel, it is complex in design and is built for high pressure, high temperature service. This type of fabricating is a "natural" for Pittsburgh Piping. We pioneered the application of austenitic steel piping materials for central stations operating at 1050°F. and above, and fabricated the piping for the world's first atomic-powered submarine and central station. Highly specialized methods, machines, and apparatus have been developed and are employed in this work. Use them on your high temperature, high pressure piping jobs.

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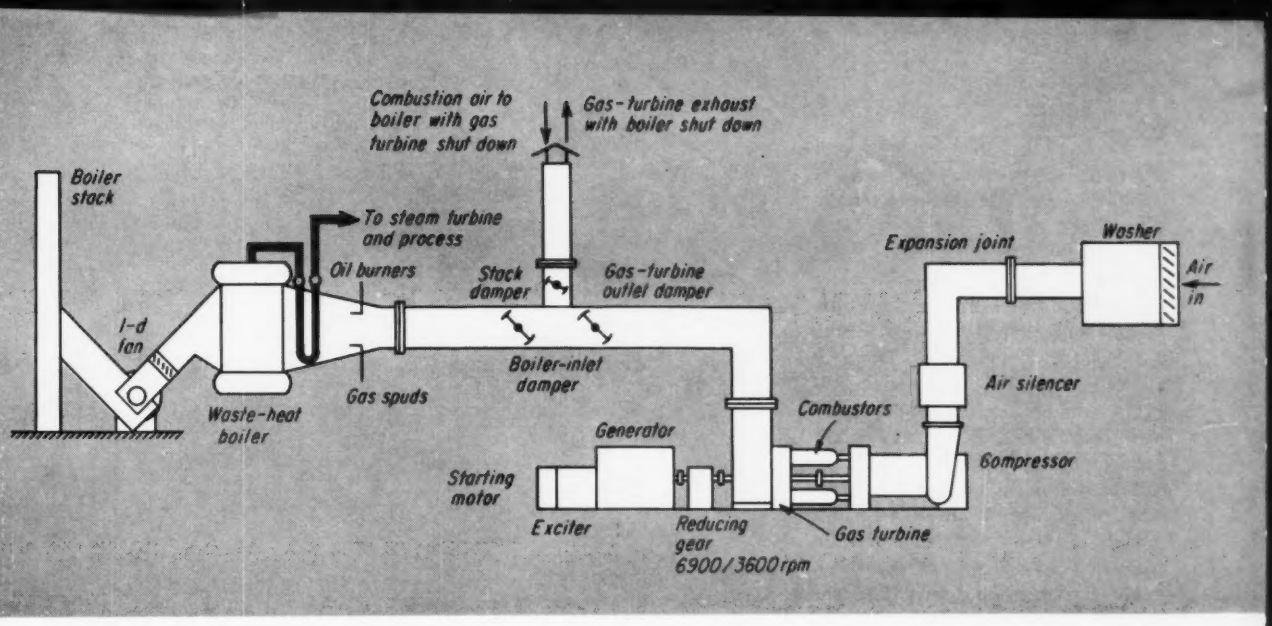


NEW PLANT CYCLE uses a 5-mw single-shaft simple-cycle gas-turbine unit exhausting into a waste-heat boiler with a capacity of 80,000 lb per hr of 250-psig 480-F steam when it's fired with either supplementary natural gas or heavy residual oil fuels

Gas turbines and waste-heat boilers . . .

. . . modernize the El Centro Power Plant of the Empresa Colombia de Petroleos in Colombia, South America. They replace seven old boilers and three noncondensing turbines

By FRANK W FOLEY, Mechanical Engineer, Gibbs & Hill, Inc

El Centro Power Plant serves the oil-well pumping field and refinery of Ecopetrol in the State of Santander, Colombia, about a 2-hour flight from Bogota. In addition to power, the refinery needs a firm process-steam supply. The area has a subtropical climate—warm with high relative humidity—though it's near the equator.

Plant changes. Most of the original equipment in the power plant was installed about 25 years ago: one 5-mw condensing turbine-generator, three 1-mw noncondensing turbine-generators, seven cross-drum boilers, and associated equipment. It was decided to retire the three noncondensing turbines, the boilers and associated auxiliaries.

These were replaced by two natural-gas-fired single-shaft simple-cycle General Electric 5-mw gas turbines each exhausting into a supplementary-fired waste-heat boiler and a third separately-fired waste-heat boiler. The three Babcock & Wilcox boilers each have a rating of 80,000 lb per hr of 250-psig 480-F steam. International General Electric Company supplied this equipment.

To assure continuity of service, the new equipment had to be erected and run before taking the existing equipment out of service and removing it. Construction and demolition schedules had to be coordinated and temporary ties were needed.

Existing plant conditions and the retained 5-mw turbine-generator set the steam conditions for the new boilers. The gas plant needs 60,000 lb per hr of steam and the 5-mw steam turbine takes 80,000 lb per hr. The three new boilers can supply 240,000 lb per hr. Total electrical capacity is 15,000 kw.

Gas turbines. Each gas turbine exhausts 396,000 lb per hr of 840-F gas to the boilers. This can generate up to 35,000 lb per hr of steam. Since the exhaust has 80% of the original combustion O_2, supplementary firing with natural gas or steam-atomized oil can bring the boiler output up to rated 80,000 lb per hr.

The gas-turbine compressors take in outside air through capillary air washers and ducts. The air compressed to about 90 psia burns with natural gas in six combustors. The 1450-F gas flows through the 2-stage turbine, a connecting exhaust duct, the waste-heat boiler, the induced-

draft fan and the stack to atmosphere.

Bailey pneumatic controllers maintain about a 2-in. wg differential across the boiler tube bank by setting the i-d fan inlet dampers. Three dampers control a bypass stack connected between turbine exhaust and boiler inlet, see sketch p 59. This allows running the unit three ways: (1) turbine exhausting to boiler (2) with boiler shut down, turbine exhausting to bypass stack (3) with gas turbine shut down, boiler taking combustion air supply through bypass stack. For total firing a fuel-air ratio controller supervises boiler operation.

Gas-turbine control. The gas turbines have semiautomatic starting and control with individual duplex control panels. The panels hold: starting and supervisory instruments, start-stop master control switch, speed switch and indicator, flame detector, turbine protection relays, temperature recorder and 24-point annunciator coupled with an audible alarm.

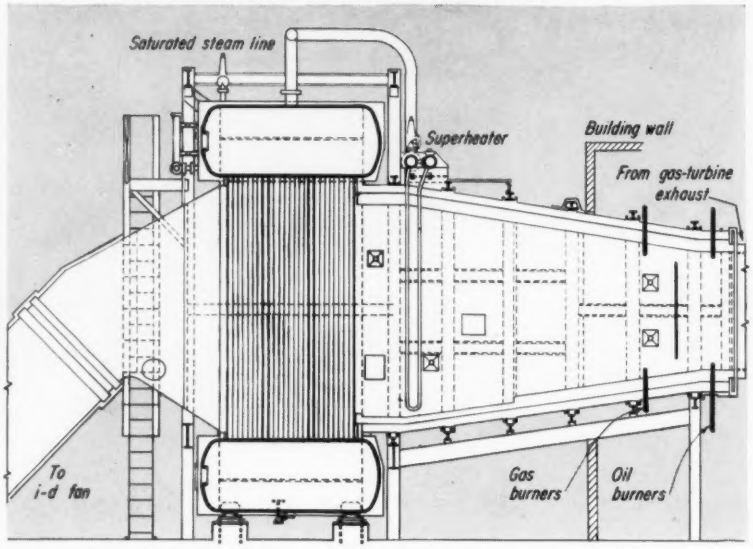
A wound-rotor motor starts the gas turbine through a disengaging clutch. The motor can be energized through a tie line from another plant.

The gas-plant compressor station supplies 50-psig gas for firing the boilers and 150-psig gas for the gas-turbine combustors.

Steam circuit. From the boilers the steam flows through a looped header to the steam turbine-generator, the gas plant, turbine-driven auxiliaries such as boiler-feed pump, circulators and condensate pumps, and through a pressure-reducing station as makeup steam for the new deaerating feedwater heater. The auxiliary-drive turbines exhaust at 5 psig to the deaerator.

Condensate flows to the deaerator from the steam-turbine condenser and the plant processes. Zeolite softeners taking their influent from an off-site river-water pretreatment plant supply makeup to the deaerator. Three boiler-feed pumps—two motor driven, one turbine driven—take water from the deaerator to discharge into a common feedwater header. Three-element feedwater control and individual boiler-feedwater regulating valves supervise water flow.

Waste-heat boilers. Burners on the boilers have a 4-to-1 turndown range. Sudden interruption of steam demand by the turbine or gas plant raised a problem. To minimize boiler safety valve wear and to maintain steam generation for sudden resumption of load, a manually controlled vent valve can exhaust main steam to atmosphere through an exhaust muffler above the roof. This gives an incidental benefit in easier boiler load range and control testing during initial startup.



WASTE-HEAT BOILER generates up to 35,000 lb of 250-psig 480-F steam from exhaust of gas turbine. Supplementary or total fuel firing generates maximum steam rating

The Bailey combustion and feedwater control systems have one complete continuous control panel with sections for the three boilers and a master control section. Meters record steam, blowdown, gas and oil flows, drum levels and condenser-hotwell conductivity. Automatic-manual selector valves are included for plant and boiler master controllers, fuel oil and gas, i-d fans, inlet dampers, feedwater control, boiler differential and fuel-air ratio selectivity. Boiler inlet and outlet draft gages mount on the panel. Purge, minimum and maximum pressure interlocks are included with supplementary fuel controls.

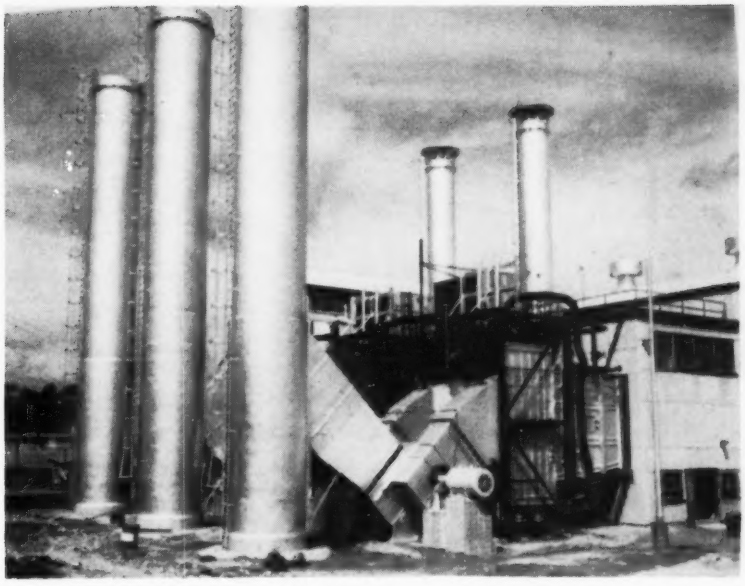
Water treatment. The pretreatment plant has a river-water pumping station that delivers raw water to a 2.3 million gallon reservoir on a hill. From here the water flows by gravity to the treatment plant. After making field surveys and tests we recommended using supplementary water treatment. Raising system flow rate to 240 gpm supplied boiler and cooling-tower makeup for the power plant of the refinery.

New equipment includes a high-rate clarifier with metered and flow-controlled influent. Batch solution type chemical feeders control hypochlorite for slime control, alkali for pH adjustment and alum for flocculation of solids in the raw water.

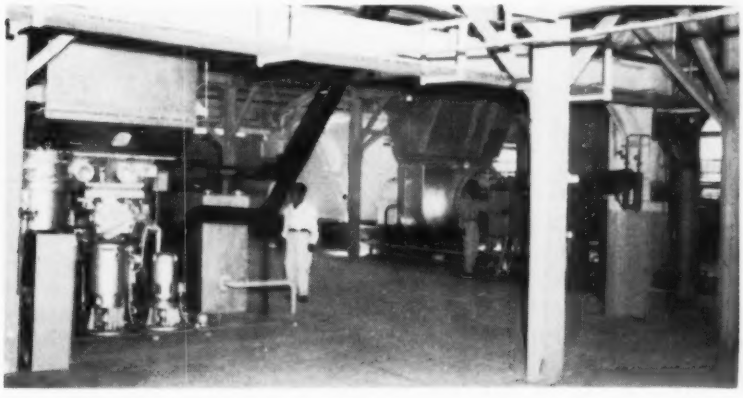
Timer-controlled blowdown removes sludge. The clarified water flows by gravity into the 10,000-gal clarified-water-storage tank. From here water is pumped through two new pressure filters and relocated zeolite softeners to the deaerating heater and the cooling tower.

The clear-water tank supplies water for filter backwashing. The clarification unit and chemical feeders run automatically with the filters and pumps controlled manually. A packaged system with proportioning pumps, solution tanks and an agitator handles phosphate and sulfite solutions. The phosphate solution goes into the boiler drums and the sulfite solution into the feedwater system.

Cooling water. Three 375-gpm cooling-water pumps take suction from the cooling tower and deliver water to the: gas-turbine-generator air coolers, turbine lube-oil coolers, flame-detector unit coolers, boiler-



THREE WASTE-HEAT BOILERS with their induced-draft fans and stacks stand outdoors at El Centro Power Plant. Two combination exhaust-intake stacks stand over building



GAS TURBINES 1 AND 2 develop 5000 kw each, stand indoors. Future Unit 3 will stand to right of Unit 2; its waste-heat boiler is already installed to supply steam

feed pump and turbine coolers, steam and boiler blowdown sample coolers, air-compressor jackets, aftercoolers and other units.

Plant arrangement. One general-service air compressor supplies pressurized air to the plant and has an aftercooler, moisture separator and receiver. This compressor, through pressure-controlled interconnections, provides a backup air supply to a similar instrument air compressor with a drying apparatus.

Units 2 and 3 were erected first in an extension to the original plant that formed an L-shaped structure. Boilers (excepting the firing equipment), stacks, air washers and the gas scrubber stand outdoors. The building extension matched the original architecture—corrugated asbestos roofing and similar type siding.

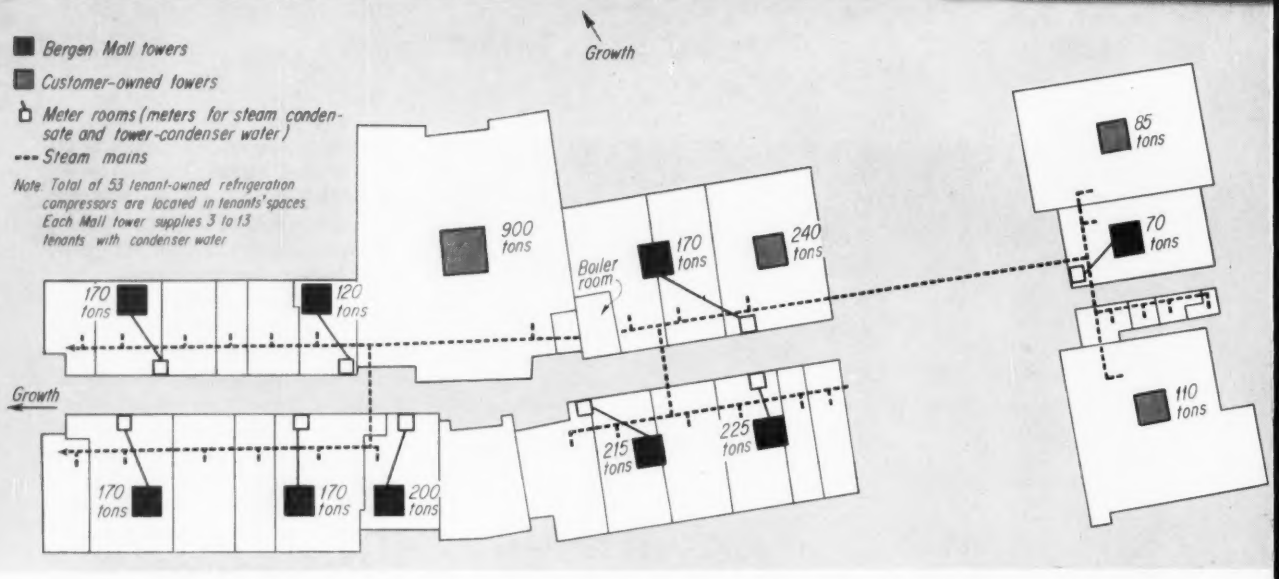
Gas-turbine and boiler-panel operating areas are radiant-heat shielded and ventilated. Engineers' offices and archives section are air conditioned. The second floor of a 2-story structure next to the main plant building stores the chemicals and has a handling hoist. The three relocated zeolite softeners, accessories and the boiler chemical-feed equipment occupy the first floor. Additional facilities installed include a repair shop, laboratory, toilets and locker room for plant operators.

Gas turbine 1, the plant deaerator, feed- and cooling-water pumps, air compressors and auxiliaries and the 480-v switchgear stand in the existing building but next to Unit 2 in the new wing. The old boilers and noncondensing turbines originally occupied this area. Units were built in the order, 2, 3 and then 1.

Electrical features. The new installation included new electrical equipment and circuits, reconnection of existing equipment retained in service, temporary connections to preclude outages during construction and removal of existing equipment and circuits. The existing 6250-kva generator was reconnected to new 2.4-kv switchgear. The two new gas-turbine-driven 6250-kva generators are connected to new 13.8-kv switchgear and existing 13.8-kv feeders. They also tie to a new 1000-kva 13.8-to-0.48-kv station-service transformer and to the 13.8-kv terminals of the existing 2000-kva transformer banks.

New 2.4-kv metalclad switchgear are supplied from the 2.4-kv delta connections of the transformer banks. This switchgear serves the existing 2.4-kv local feeders and a new 1000-kva 2.4-to-0.48-kv station-service transformer. The latter serves the new metalclad 0.48-kv switchgear for both new and retained-in-service auxiliaries. The new electrical features include: two 350-hp 440-v wound-rotor type motors for gas-turbine starting, unit cubicle-assembled neutral-ground resistors, station-control battery and charger with dc distribution panel, complete lighting system and complete plant grounding system. The electrical construction had to be coordinated with overall erection, replacement and demolition schedules of the project.

Economics. The gas turbine, waste-heat boiler, existing steam-turbine cycle showed a calculated heat rate up to 25% better than for an equivalent extraction steam turbine. This was aided by the process steam demand at 250 psig and the favorable kw-to-process steam ratio. The combined cycle has an installed cost saving of about 6%, compared to equivalent steam cycle of the same capacity, depending on ambient temperatures.



MALL DELIVERS cooling-tower water and steam to tenants' air-handling units. Warm condenser water and condensate then go to meter rooms. Steam and water meters, tower pumps and fan-pump controls grouped here simplify meter reading and cycle maintenance

Decentralized cooling eases 3-step

N.J.'s Bergen Mall shopping-center tenants supply own cooling means, Mall provides steam. Result: minimum cooling headaches while center expands

By J E WELKER, Bergen Mall, Allied Stores, Inc

Air conditioning in shopping centers is no longer a luxury. Today it ranks in importance with good heating and lighting systems. Customers demand year 'round shopping comfort and it's up to the shopping center to provide it. But the question is—how?

Question came up before Allied Stores, Inc, owners of Bergen Mall shopping center near Paramus, N. J., before construction of Mall started in early 1956. Allied management had to weigh two major factors: (1) The Mall would be built in three stages at about one-year intervals, with each stage adding 900 to 1800 tons cooling load to the center. (2) Most tenants would be small and all available space would not be occupied immediately after completion of a stage. Therefore small amounts of load would continue to be added for several months after each construction phase was finished.

Decision went to the decentralized cooling system. Major influence was the 3-step growth plan. Anticipated final cooling load was 5000 tons, but it wouldn't be reached for three to four years after completion of first phase. By using a noncentral theme, cooling load could be tied directly to both Mall's growth and tenant occupancy dates. So Allied figured tenants to provide their own cooling equipment, while Allied supplied steam. There's one exception to that rule. The Mall installed nine low-silhouette cooling towers to deliver condenser water to small stores. (Four of the present 53 tenants have large loads and individual towers.)

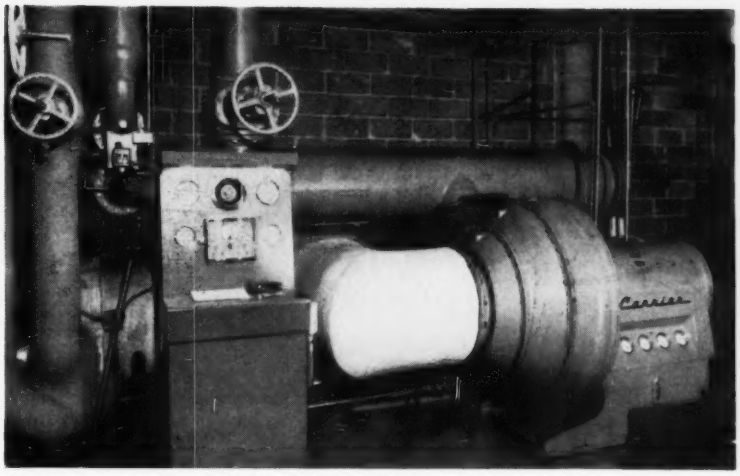
First stage was completed in late 1957. Seven buildings were erected, with the first five tenants moving in Nov 14, and the balance came along at one to two month intervals during the following year.

Largest tenant to open at that time was Stern's, a 4-story department store. They use a 900-ton centrifugal compressor to cool chilled water piped to 28 ceiling hung fan-coil air-handling units distributed through the Mall and second floor. Condenser water for compressor is furnished by Stern's tower.

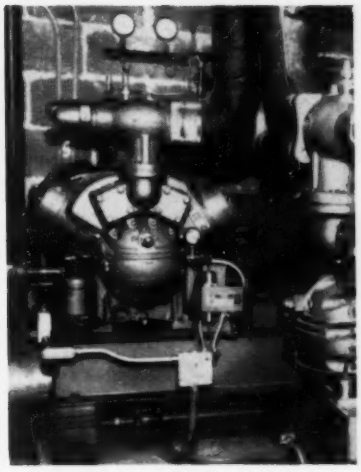
Second-stage construction should be wrapped up ready for occupancy late this year. Plans for third and final stage are still tentative. Total load to date is 2700 tons capacity, of which about 2300 tons is in service. Load is composed of Stern's 900 tons plus that added by the 52 additional tenants brought in so far by completion of the first phase.

Compressors and air-handling units are either Mall or tenant owned. Most stores use reciprocating compressors (10 to 60 tons capacity) for cooling effort and pipe refrigerant to direct expansion coils in the air-handling equipment. The two department stores, including Stern's, use centrifugal compressors plus a chilled-water system, while two large food stores have packaged units (with no ductwork) handling 85- and 110-ton loads each in their spaces.

Air distribution is through ductwork for all but the two food stores and twelve retail stores. Ceiling-hung



CENTRIFUGAL COMPRESSORS (240 tons, *above*, and 900 tons) serve the two largest stores in the center. Two other tenants use only packaged units for 85- and 110-ton loads



DIRECT-EXPANSION COILS, fed by reciprocating compressors, cool most stores

growth plan

air-handling units, both single and multiple zone, keeps equipment out of valuable selling and stock space, cutting true cost of installation and operation. Tenants were given option to have their equipment installed by Allied's contractors during construction or wait and take care of it by their own arrangements.

Meter rooms are another Mall-owned feature. Part of the tower-condenser cycle, they have several uses. Main idea is grouping of tenants' meters in a few convenient areas so meter reading doesn't involve going to each tenant's area. In order to make the best use of these rooms, main tower-condenser valving, fan and tower controls and tower pumps (one at 1/3 capacity and two at ½ size) are also located there. Arrangement cuts installation, maintenance costs by grouping most frequently worked-on equipment in a few areas.

Controls for compressors and air-handling equipment is on an individual tenant basis. Each tenant has a completely automatic control system, permitting him to switch from winter to summer operation (or the reverse) during mild winter days. Controls for 2-speed tower fan and the three tower pumps (spotted in meter rooms) automatically start up and shift tower fan speeds, cutting pumps in and out as load changes. Pumps must be manually started every morning, but then an automatic control takes over.

Cooling load isn't limited to summertime. Although heaviest outside heat load comes in summer, so does the lowest customer traffic. Greatest customer load occurs just before Christmas at the Mall, as it does in many other shopping centers. If days are mild, system operators often have to jack up cooling equipment and put it on line for comfort of customers.

Although the Mall has only two heating seasons under its belt, cooling has already played its part. Stern's compressors ran 25 days during November and December of 1957 and 16

Principal air-conditioning equipment

Type	No.	Capacity
Compressors		
Centrifugal, chilled water	2	240,900 tons
Reciprocating, chilled water	1	60 tons
Reciprocating, direct expansion	36	10 to 40 tons
Packaged units	19	3 to 7½ tons
Air-handling equipment		
Ceiling mounted fan-coil single- and multiple-zone units	80	
Cooling towers		
Bergen-Mall owned	9	50 to 225 tons
Tenant owned	4	85 to 900 tons
Boilers		
Field erected, 15 psig oil fired	3	10,000 lb per hr
Packaged, 15 psig, oil fired	1	4,000 lb per hr
Packaged, 15 psig, trash fired	1	6,000 lb per hr

days during that same period last year. Reduction in cooling in 1958 was tied to degree-day increase.

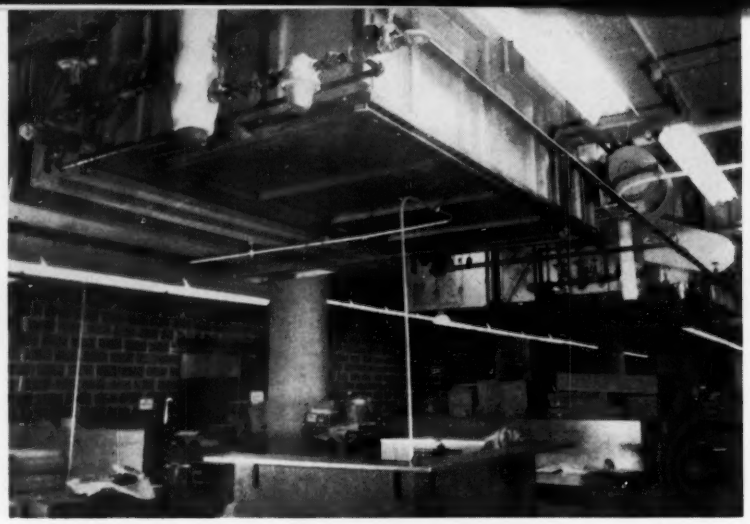
Changeover from heating to cooling comes when outside temperatures hit 55 F. At 50 F operators get ready to make the change and when 55 F arrives compressors are started, steam valves closed. Need for switch is seen from fact that inside temperatures will reach 85 F even with 100% outside air going through ducts if outside air climbs to 65 F.

Steam side. Steam system at the Mall follows the central concept. Boilers in project boiler room supply steam for all tenants' heating and restaurant needs. Three low pressure (15 psig) 10,000-lb-per-hr field-erected boilers supply heating steam during winter; one 4000-lb-per-hr packaged unit serves in summer. Up to 3500 lb per hr of trash can be burned to turn out a maximum of 6000 lb steam per hr from a waste-heat boiler (300,000 to 400,000 lb per month with present trash burning).

Distribution is by way of basements to tenants' air-handling units. Condensate is led back to condensate meters in meter rooms, collected in common returns and sent back to boilers.

Balance of power services are distributed but not supplied by the Mall. A 1500-ft delivery tunnel under the main pedestrian walk keeps delivery trucks off the street level and also serves for electrical and gas distribution. Power is brought in at 4100 volts, transformed down to 440, 220, and 110 volts.

Decentralized cooling at the Mall was adopted for other than step-construction reasons. Tenants' selling hours vary from 10 to 16 per day, 5 to 7 days per week. At present, one store with a 50-ton load is open until 2 am every night and all day Sunday. In order to service such store hours with a central system, operating hours of the Mall would be increased about 50 hours per week over their present schedule. Some tenants—candy store, restaurants—usually have peak loads when rest of the Mall is quiet. Servicing these areas would require purchase of small machines in addition to the large central operation units, and would tend to defeat the advantage of a central scheme.



CEILING-HUNG air-handling units free valuable space to tenants for selling, stock use. Multi- and single-zone units are installed for chilled water, direct expansion

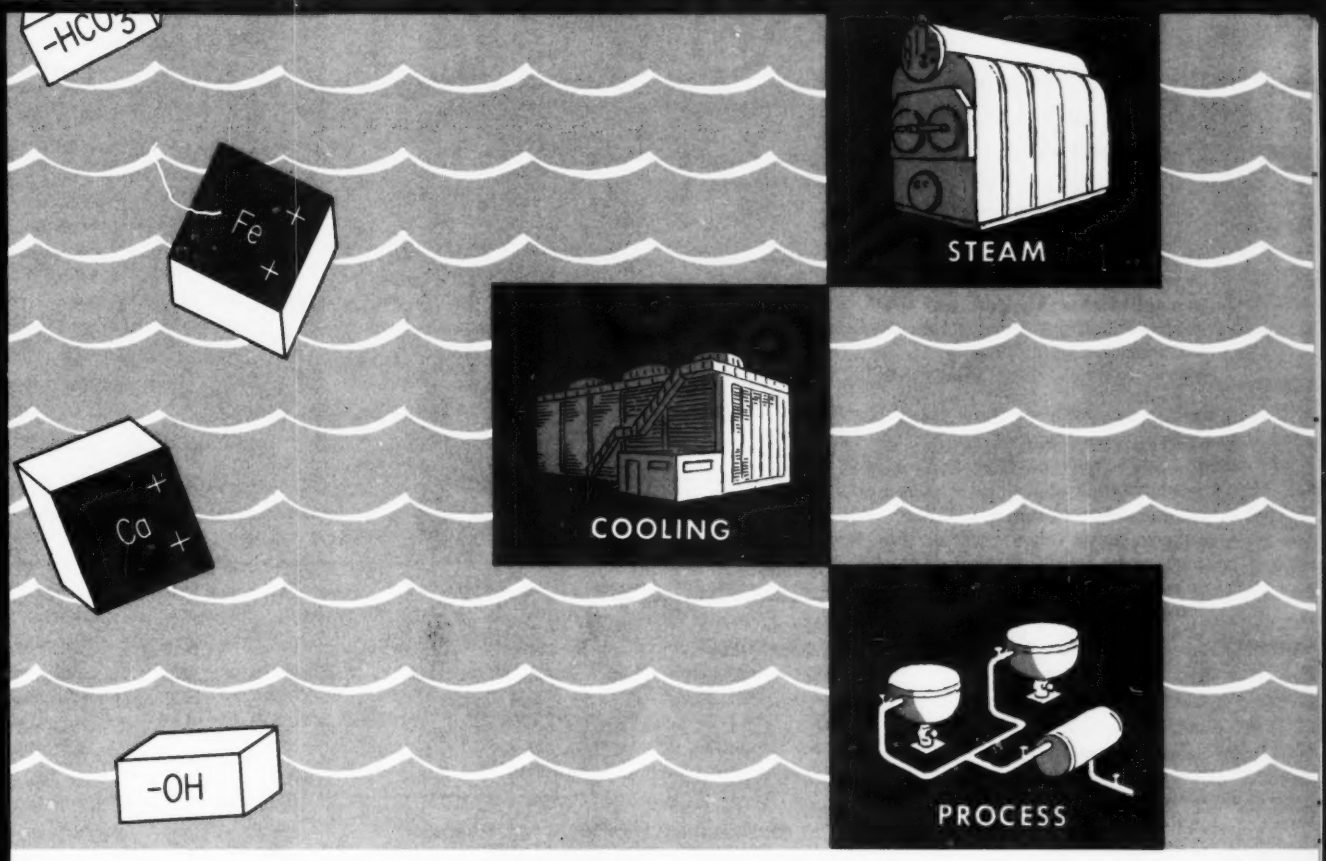
Airstream forms invisible door

Two largest air doors—air streams used as doors—in the U.S. are found at Sterns. Each door presents a 20-ft wide free entrance to the store, also acts as air-conditioning relief valve. Advantage to customer—safety. There are no doors to push or pull, swing too freely, revolve too fast. Even small exchange of air between door and outside air helps. Escaping air keeps approaches to doors dry, cutting slipping hazard.

Operation is relatively simple. For each door, two ceiling hung fan-coil air-handling units push 22,000 cfm through adjustable louvres over each entrance, photo, above. Air passes across opening at 1000 fpm, returning to fans through floor-mounted grills set just inside entranceways. Giving louvres slight outward pitch aims air stream out doorway to offset effect of winds blowing toward opening.

During zero weather air stream is kept at 70 F by steam coils, graduated to 60 F as outside air approaches 60 F. This air stream is not conditioned during the summer months.

Regular doors are set in frames and raised into wells over entrances. They're lowered to normal door position when either the store closes or air door air-handling equipment is secured.



PART TWO

Water Treatment

By R H MARKS, Assistant Editor

What treatment is available? 66
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Ways to cut water consumption 88

Broadly viewed, industry uses water to generate steam, to cool and heat, to fill the varied needs of process and general plant services. These are the areas we are concerned with in this report.

Steam generated may power turbines in central stations and industrial plants, or may be fed to space or process heaters. But the water must first be treated. We see huge quantities of water used daily to cool power-plant condensers, compressors, diesel engines. We see steel mills, oil refineries and chemical plants gulping billions of gallons of cooling water . . . treated water.

Transporting and processing of materials, as in the pulp and paper industry, is a job for water. It's also a raw material that becomes part of a finished product such as in canned foods and beverages. General plant-service water is used for drinking and washing.

Water that can be used without some treatment is rare indeed. Impurities must be removed, reduced or stabilized. Part 1 of this report (POWER, December 1958) discussed water impurities, treatment aims and basic water chemistry, while taking a hard look at treatment chemicals and application equipment. Here we show how those chemicals and equipment help solve everyday water problems.

a **Power** special report
March 1959

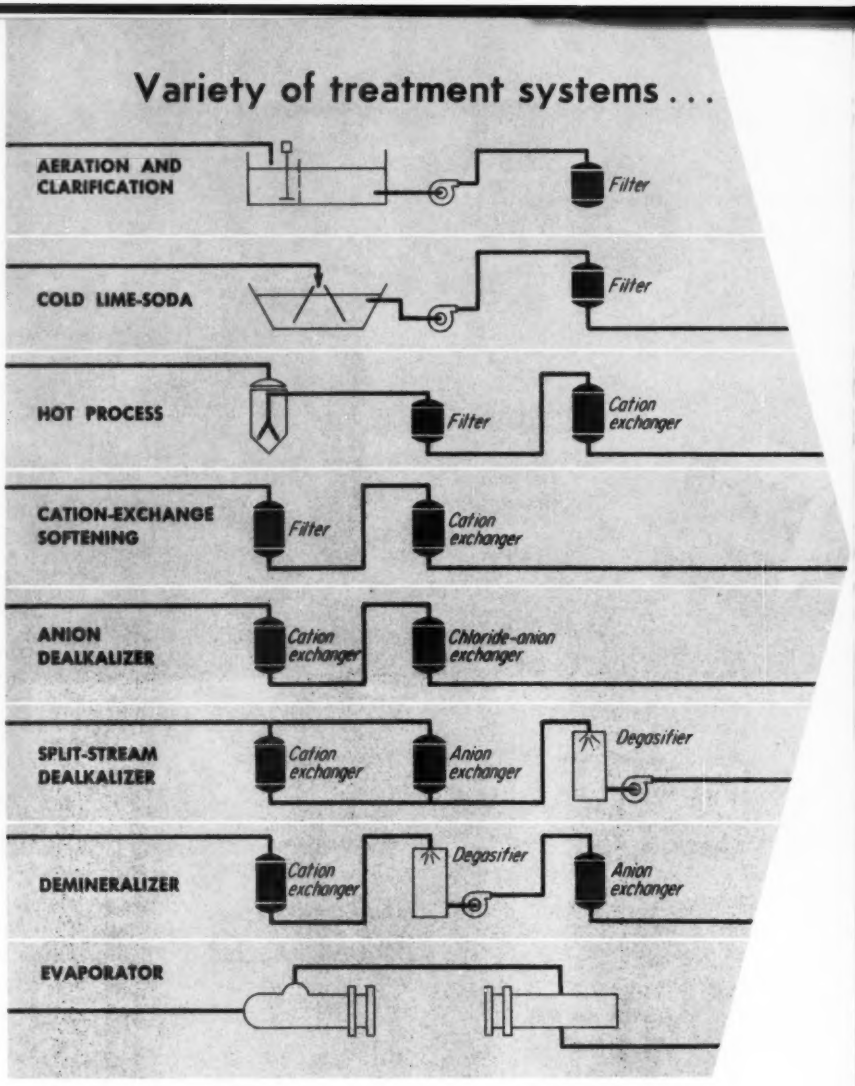
Rivers, wells, lakes, even the oceans, may be best water source

Always think of treatment that incoming water might need when you stack one source against the other. Good rivers offer ample quantity, rapid flow, low hardness and temperature. But dissolved mineral matter, including hardness, may have a yearly maximum that's 2 to 3 times the minimum. Clear river water for once-through cooling will probably need little treatment. But most rivers, carrying high dissolved and suspended solids plus organic matter, need extensive treatment.

Sometimes it's more economical to pump water from a distant lake than to use a nearby river that's badly polluted. Lake water is fairly constant in composition and seasonal changes in turbidity are somewhat predictable. It may be softer than well water, but probably contains organic matter that must be removed.

Well waters usually run fairly constant in composition and are often quite hard. Properly protected deep wells are usually secure from contamination. Water is clearer, has fewer organic colors, tastes and odors than most surface supplies.

Consider sea water where cooling is your basic water need. Supply is practically inexhaustible. Fresh water needs can then be met by city supplies, surface or well sources. Desalting sea water for potable use isn't yet economical in most areas.



Treatment choice varies with water analysis and use

No matter where you find water it will probably have to be treated before use. Even city water, usually the best available to an industrial plant, needs further treatment for boiler feed, cooling and process.

Undesirable water impurities for industrial use fall into these main groupings: (1) dissolved mineral matter (2) dissolved gases (3) turbidity (4) color (5) taste, odor and (6) microorganisms. Amount tolerated in any given water depends mostly on what the water is used for.

Most large industrial plants use a private water supply since it's usually cheaper to pump water than buy it from a city system. Some well-engineered plants buy city water for drinking and fire protection only. Then the larger amounts needed for process, cooling, etc are drawn from river, well, lake or harbor.

Deciding what water treatment to use is a job for the water consultant. Selection must take into account present and future plant-water needs along with an analysis of the water supplies available. Treatment will probably involve one or more of the basic processes shown above. These processes along with the basic chemicals are your tools of treatment for plant water needs, facing page.

Aeration helps remove undesirable gases and volatile impurities. These include hydrogen sulfide, carbon dioxide and volatile organic matter. Iron and manganese are also oxidized and removed by coagulation, settling, filtering.

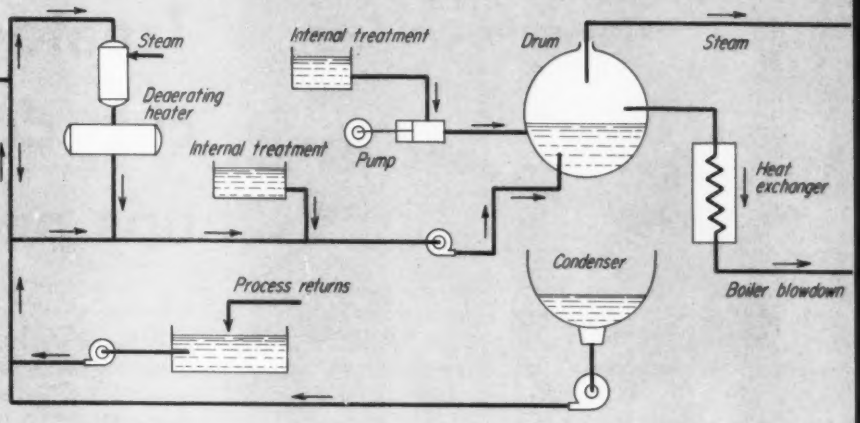
Clarification equipment removes bulk of turbidity and sediment found in most surface supplies. It's usually first step in treatment since most applications call for a water that's clear and colorless. Coagulants and coagulant aids speed up settling process. Filters follow to remove residual turbidity. If turbidity is moderate to start with, filters may handle the job alone. Coagulants or filter aids are used depending on the design of the filter.

Cold-lime soda unit precipitates scale-forming salts of

. . . and chemicals tailor water supply to fit each plant need

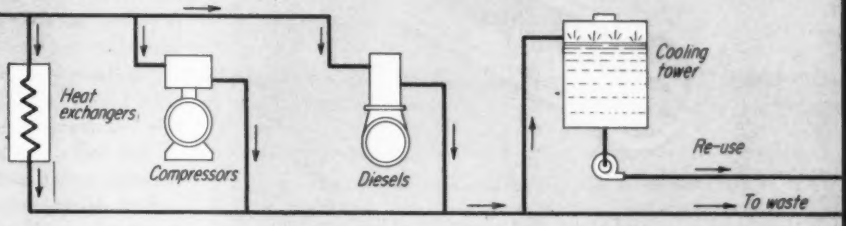
Steam generation

Boiler-feedwater quality specifications depend largely on boiler operating pressure. As pressure increases, quality requirements go up. In general, feedwater should be deaerated. Internal chemical treatment is also called for in all cases. This may handle the complete job alone or supplement external-treatment equipment, left. Amount and analysis of makeup will also affect treatment.



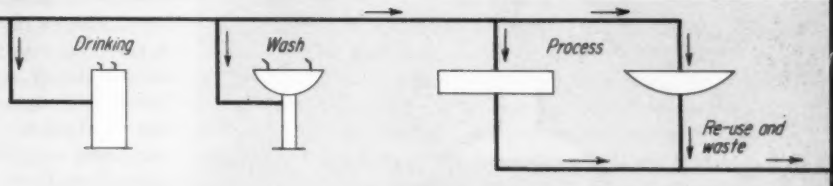
Cooling and heating

Cooling-water quality can vary over a rather wide range. It depends on water analysis, type of cooling system—once-through or recirculating—where cooling water is used and the maximum temperature that it reaches.



Process and general purpose

Process-water needs vary with each industry. Most general-purpose water must be clean, colorless, palatable, and free of all pathogenic bacteria.



calcium and magnesium. It reduces hardness, alkalinity and removes turbidity. For zero turbidity and hardness, follow with filters and sodium-cation softeners.

Hot process also reduces hardness, alkalinity and turbidity. But steam must be available for heating and there must be a need for hot treated water. This usually limits its use to the preparation of boiler-feed makeup. It has added advantage of reducing silica and can handle a fair amount of turbidity without need for pretreatment.

Cation-exchange softeners are widely used whenever there is a demand for soft water. Simple to operate, these units produce soft water as long as the ion-exchange resin is properly and regularly regenerated. Filter the incoming water if turbidity is above the range of 5 to 10 ppm.

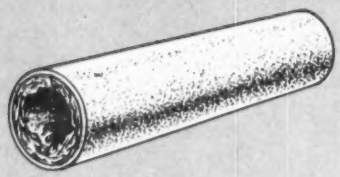
Anion dealkalizer is preceded by a cation-exchange softener. Treated water has zero hardness and is low in alkalinity. Anion unit is regenerated with salt and a small amount of caustic. This method is used primarily for treatment of makeup to small low-pressure boilers.

Split-stream dealkalizer uses hydrogen- and sodium-cation exchangers to produce a soft supply with low alkalinity. Salt and sulfuric acid are used for regeneration. Elaborate blending controls may be needed, but the whole plant can easily be made automatic. Carbon dioxide released when hydrogen and sodium streams are blended is removed in either a forced-draft or vacuum degasifier.

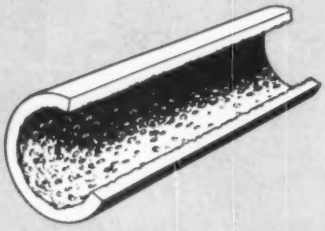
Demineralizing plants remove practically all dissolved solids from water. When a weak-base anion exchanger is used, everything is taken out except silica. This water is completely satisfactory for many process jobs. But, since silica removal is a must for high-pressure boiler makeup, strong-base anion-exchange material is used to reduce silica below 0.02 ppm. Operating and equipment cost for this method is usually higher than the other treatment processes. For this reason, and to improve quality, considerable emphasis is placed on multibed arrangements with special regenerating techniques. Aim is to cut overall investment and chemical operating costs. Even though these systems are complex, automatic controls simplify the operators job of keeping track of the process.

Evaporators compete with ion exchange for the task of removing all dissolved solids and silica from high-pressure boiler feedwater makeup. Demineralizing has gained ground in many other areas because of lower chemical operating cost. Increasing number of evaporator effects cuts heat consumption but increases first cost of the plant.

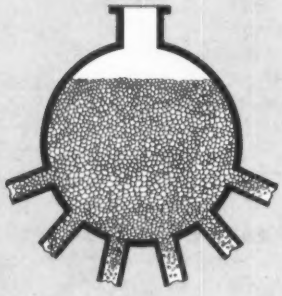
Boiler-feedwater troubles fall into four basic categories



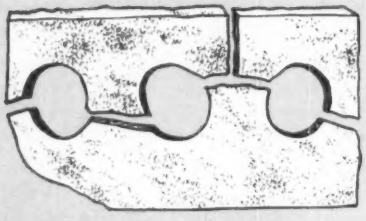
SCALE reduces heat transfer, causes overheating of tube metal. It forms when boiler water containing dissolved calcium, magnesium salts, silica, etc is evaporated



CORROSION of boilers, economizers, feedwater heaters, condensers, piping, etc shows up in a host of ways. Main cause is presence of dissolved oxygen and carbon dioxide



FOAMING and priming cause boiler-water carryover with steam. Results: erratic superheat, engine and turbine mechanical trouble, superheater and turbine-blade deposits



CAUSTIC EMBRITTLEMENT occurs on drum seams, under rivets and at tube ends where water flashes to steam through any small leaks in these highly stressed areas

Treated feedwater cuts downtime, ups performance

Main objective of boiler-feedwater treatment is elimination of the troubles caused by scale, corrosion, carryover and caustic embrittlement. Box, left, helps explain the nature of these problems.

Hard scale on tube surfaces reduces heat transfer to the fluid inside. Contrary to common belief, this reduced heat flow rate may not greatly affect boiler efficiency. Total heat absorbed by conduction and convection through heating surfaces covered with 0.10 to 0.20 in. of scale may be only 1 to 3% less than when the surface is clean. While this loss seems small, it adds up to a respectable amount of fuel for a year's operation. It may also upset balance between boiler and superheater, economizer, preheaters.

Real danger from scale lies in radiant-heat zone where boiler-tube metal sees combustion—waterwall and first-pass tubes. This radiant heat converts into sensible heat in tube metal without regard to waterside conditions. When scale is present to retard removal of this heat by the steam-water mixture inside, metal temperature of the tubes starts to climb. Even a very thin coat of scale in high heat zones can overheat the metal enough to rupture the tube. Accumulated corrosion products inside the tube will have the same effect. Once scale forms, only remedy is to remove it chemically or mechanically and then treat the boiler water or feedwater to keep the same thing from happening again.

Ordinary scale is the result of heating and concentrating the dissolved hardness in water. Feedwater containing dissolved and suspended solids flows into the boiler for continuous generation of steam. Since steam is practically pure, solids are left behind to concentrate. The fact that salts such as calcium sulfate become less soluble as temperature rises accelerates scale-forming tendencies.

Chemically, scale will usually consist of insoluble compounds of calcium and magnesium. Sometimes it's cemented into a hard mass by silica. Under severe conditions it may consist wholly or partly of complex silicates, iron or copper oxides.

Scale formation is prevented by: (1) *External* or *pretreatment* — removing or reducing calcium, magnesium or silica before feedwater reaches the boiler. (2) *Internal treatment* — adding chemicals to the boiler water, causing solids to form a fluid, nonsticky sludge. (3) *Blowdown* — removing concentrated boiler water containing both dissolved solids and sludge.

As boiler pressures get higher, scale problem becomes more critical. Higher boiler-water temperatures produce faster chemical reaction rates and higher tube temperatures. Since tube metal is closer to its sagging point, scale can cause bagging, blistering and rupture more quickly.

Other plant operating conditions affecting scale prob-

External treatments remove impurities from makeup water before they enter the boiler

Quality of treated water produced by various external treatment methods in common use is an important factor in their selection. Table, right, shows what you can expect in the way of hardness reduction, residual alkalinity, potential carbon dioxide in steam, dissolved solids reduction and silica removal. Quality of makeup water needed depends primarily on boiler design, particularly operating pressure and temperature. Degree of treatment called for also depends on boiler capacity, quantity of condensate returns available and raw-water analysis. Large plants with a high percent makeup usually justify more elaborate external treatment than a small installation. All these factors influence your common-sense answer to the question "How good must makeup water be?"

Method of treatment	Average analysis of treated water				
	Hardness ppm as $CaCO_3$	Alkalinity ppm as $CaCO_3$	CO_2 in steam (potential)	Dissolved solids	Silica
Cold lime-soda	30 to 85	40 to 100	Medium-high	Reduced	Reduced
Hot lime-soda	17 to 25	35 to 50	Medium-low	Reduced	Reduced
Hot lime-soda phosphate	1 to 3	35 to 50	Medium-low	Reduced	Reduced
Hot lime-zeolite	0 to 2	20 to 25	Low	Reduced	Reduced
Sodium-cation exchanger	0 to 2	Unchanged	Low to high	Unchanged	Unchanged
Anion dealkalizer	0 to 2	15 to 35	Low	Unchanged	Unchanged
Split-stream dealkalizer	0 to 2	10 to 30	Low	Reduced	Unchanged
Demineralizer	0 to 2	0 to 2	0 to 5 ppm	0 to 5 ppm	Below 0.15 ppm
Evaporator	0 to 2	0 to 2	0 to 5 ppm	0 to 5 ppm	Below 0.15 ppm

lems include (1) ratio of makeup to condensate returns (2) boiler operating schedules and (3) condenser leakage and other feedwater contamination. For example, if makeup is a high percentage of total feedwater, elaborate pretreatment may be justified. This is also true when boilers must steam at high rates for long or intermittent periods.

Corrosion of boiler metal will take place when (1) water is acid or (2) dissolved oxygen, carbon dioxide or other corrosive gases are present. Boilers, economizers, feedwater heaters, piping, etc must be protected from corrosive attack. (For detailed info on this subject see POWER's Special Report, *Corrosion*, Dec 1956).

Preventive treatments include (1) neutralizing acidity and raising pH with an alkali (2) removing dissolved gases in a deaerator and following up with a chemical scavenger (reducing agent) to combine with any remaining traces of oxygen (3) neutralizing effect of carbon dioxide with ammonia or neutralizing amines (4) depositing a protective film on metal surfaces (filming amines).

Carryover is entrained moisture and associated solids passing from a boiler with the steam. Erratic superheat and mechanical troubles with engines and turbines are caused by these slugs of moisture. Carryover also deposits solids in superheaters and on turbine blades. It may even spoil materials in process. Main causes of carryover are *priming* or *foaming* or both.

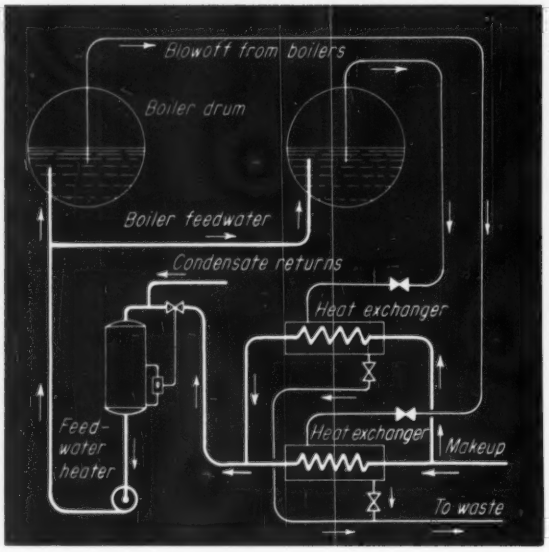
Priming is the spouting or surging of water into the steam outlet. It's caused by too high a water level, uneven fire distribution, load swings, too high a steaming rate or even faulty boiler design. Remedies range all the way from redesigning the boiler or steam drum to installing steam purifiers, lowering water level, improving firing distribution or reducing boiler load. Chemical antifoams also help.

Foaming is the formation of small, stable noncoalescing bubbles throughout the boiler water, box, facing page. Water film around each steam bubble generated at the heating surface is stabilized by an increase in dissolved and suspended solids in the boiler. In other words, the bubble skin becomes tough and doesn't permit coalescence or break readily when the bubble emerges. Resulting expansion of boiler water permits carryover and priming.

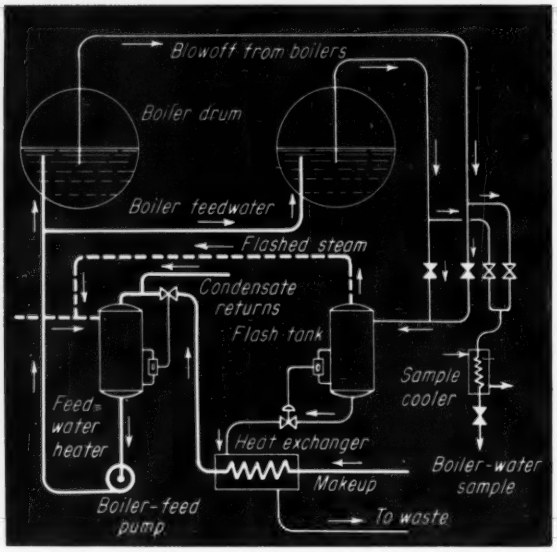
Main causes of carryover are excessive dissolved and suspended solids, high alkalinity, presence of oil and various organics that react with alkalinity. Steam washers and mechanical separators in boiler drums effectively control carryover within reasonable and tolerable limits. Notable exception is silica that passes over with steam as a vapor at operating pressures above 600 psi. Proper water treatment including the right amount of blowdown is the key to maintaining these limits.

Caustic embrittlement or intercrystalline cracking of metal takes place when all of the following conditions are present. (1) Boiler water must have embrittling characteristics and be capable of attacking boiler metal. This calls for presence of free hydroxide alkalinity and some silica. (2) Slow leakage of boiler water through a joint, seam or crevice must occur. As the boiler water escapes, it flashes to steam leaving dangerous concentrations of hydroxide alkalinity in the crevice. Average concentration of hydrate alkalinity by itself isn't enough to cause embrittlement. (3) Boiler metal must be highly stressed at the point of leakage. This may be caused by faulty riveting practice, misalignment, cold working, expansion, etc.

It's generally conceded that maintaining ASME sulfate-carbonate alkalinity ratios will not give consistent protection against embrittlement failure. So this control procedure has been largely discarded in favor of other improved methods, including use of inhibitors like sodium nitrate, lignin derivatives, tannins or regulation of boiler-water alkalinity by coordinated pH-phosphate control.



CONTINUOUS BLOWDOWN RATE from each boiler is individually controlled. Heat is recovered in makeup flow to feedwater heater



FLASH TANK receives controlled amounts of blowdown from one or more boilers and produces flashed steam for feedwater heating

Blowdown removes boiler-water solids

All dissolved and suspended solids entering a boiler with the feedwater remain in the drum and tubes as steam is generated. Continued addition of makeup produces higher and higher solids concentration in the boiler drum. Finally, a point is reached beyond which operation is completely unsatisfactory. The limit may be suspended solids, total solids, silica content, alkalinity, etc. Recommended boiler-water concentrations at various operating pressures are listed on the facing page, lower, right.

Every boiler has a limit for total solids above which priming and carryover occur. Units with ample drums, operating at comparatively low steaming rates, can tolerate 2500 to 5000 ppm total solids. But high-pressure boilers, operating at high steaming rates, call for concentrations of 500 ppm or less to produce steam of acceptable purity. To keep within these limits some of concentrated boiler water must be removed from the drum. So all boilers have blowdown connections — some required by codes, some specifically for chemical control.

Intermittent blowdown is taken from bottom of the mud drum, waterwall headers or lowest point in the circulation system. Blowoff valve is opened manually to remove accumulated sludge. This is done every 4 to 8 hours, or when the boiler is idle or on low steaming rate. Main disadvantage is the waste of hot water. Also, control of boiler-water concentrations is irregular at best. Keeping within safe limits means the operator must maintain a rigid blowdown schedule. Otherwise it's possible to have priming and foaming with resulting carryover.

An external concentrator tank is sometimes piped to the boiler drum. Boiler water thermally circulates to top of this tank and back to the steam drum or a lower point on the boiler. Suspended solids fall to bottom of the concentrator tank. Blowdown then discharges from concentrator to waste. This ejected water contains more suspended solids than an equivalent amount of circulated boiler water.

Continuous blowdown automatically keeps boiler water within desired limits. Continuously removing a small stream of boiler water keeps the concentrations relatively constant. Savings from the heat-recovery features often pay off initial equipment investment in short order. Box, facing page, shows a 4-step approach to calculating blowoff rates and evaluating potential heat savings.

Connection for continuous blowdown is taken from that part of the boiler circulation containing the most concentrated water. In modern units most of the solids are in solution and are best taken from the steaming drum at some point below normal water level. With this kind of system intermittent blowoff valves should be opened occasionally, but on a regular schedule, to discharge sludge from the mud drum or lower header.

Nonflash system, upper left, is generally used for relatively low-capacity low-pressure boilers with low blowdown rates. Usually blowdown from each boiler discharges to waste through separate heat exchangers.

Flash system, upper right, is economical for larger capacity boiler plants where the amount of blowdown is substantial, and the resulting flashed steam can be used conveniently. Boiler water enters the flash tank through a flow-control valve. Since the flash tank operates below boiler pressure, a portion of the blowdown water immedi-

Four steps to evaluating a continuous blowdown system

Let's take a 250-psi boiler with an evaporation rate of 15,000 lb per hr. Makeup-water analysis shows 170 ppm total solids. Temperature is 60 F.

(1) Calculate percent boiler blowdown. Maximum allowable total solids in the boiler water varies with boiler pressure. Table, below, sets this at 3500 ppm for a 250-psi boiler. Solids entering with makeup concentrate as steam is produced. Blowdown removes this concentrated boiler water. To hold solids at a given level, amount entering with makeup must equal that removed by blowdown. Let X equal blowdown, Y the makeup water flow. Then:

$$170 \text{ ppm } (Y) = 3500 \text{ ppm } (X)$$
$$(X) = 170/3500\ (Y)$$
$$(X) = 0.05\ (Y) \text{ or } 5\%\ (Y)$$

In some cases, depending on makeup analysis, percent makeup and type treatment, suspended solids rather than total solids are controlling factor in calculating blowdown. But general approach is still the same, after solids limitation is set.

(2) Then determine feedwater flow. Boiler produces 15,000 lb steam per hr. So maximum feedwater flow must equal this amount plus the water lost through blowoff. In this case, blowoff (Y) at 5% of makeup flow with no condensate return amounts to:

$$Y = 0.05\ (15{,}000 + Y)$$
$$Y = 750/0.95 = 800 \text{ lb per hr}$$

Total feedwater flow is 15,000 plus the 800 or 15,800 lb per hr. If the system calls for 50% makeup with the remainder, condensate returns:

$$Y = 0.05\ (7500 + Y)$$
$$Y = 375/0.95 = 395 \text{ lb per hr}$$

Total feedwater flow is then 7500 plus 7500 plus 395 for a total of 15,395 lb per hr. We are ignoring any solids present in the condensate. This is usually done in practice unless it is badly contaminated or is a considerable portion of the total feedwater flow.

(3) Now calculate flashed steam available. Boiler blowdown can provide low-pressure steam for feedwater heating or process. Just discharge it into a flash tank at lower pressure. Amount of steam produced depends on operating conditions.

$$\text{Steam flashed, } \% = \frac{h_1 - h_2}{H_L}$$

where h_1 = heat of water entering flash tank
h_2 = heat of water at flash pressure
H_L = latent heat of steam at flash pressure

Now refer to a steam table. Heat of water at 5 psi flash pressure is 196.1 Btu per lb. Its latent heat equals 959.9 Btu per lb. Heat of water at the 250-psi level is 381.6 Btu per lb. Then:

$$\text{Steam flashed, } \% = \frac{(381.6 - 196.1) \times 100}{959.9} = 19.4$$

This amounts to 19.4% of 800 or 155 lb per hr leaving the flash tank. Remaining water (645 lb per hr at 227 F) drains from flash tank to a heat exchanger where it gives up additional heat to the incoming feedwater.

(4) Finally, calculate heat savings. If the final blowoff heat exchanger has a terminal temperature difference of 15 F, blowoff is discharged to the sewer at 60 + 15 F or 75 F. Except for this terminal difference all blowoff heat can be reclaimed in the feedwater. Total heat in this blowoff is 800 (381.6) or 305,280 Btu per hr. Heat going to the sewer as residual blowoff above 60 F equals 645 (15) or 9675 Btu per hr. So heat saved is 305,280 — 9675 or 295,605 Btu per hr. Using this, dollar heat savings per yr are: Btu per hr saved × hours of operation per yr × fuel cost per ton ÷ fuel heat value × Btu per lb × 2000 lb per ton × boiler efficiency.

ately flashes into steam. This is sent to the deaerating heater or some other steam system. If boiler pressure is high enough to permit flashing at intermediate pressures, one or more flash tanks can be added in series for a multistage system. Individual blowdown lines from each boiler are connected to a blowdown manifold on the first-stage flash tank. Residual blowdown leaves each flash tank through a direct water-level actuated drainer valve. Remaining blowdown is finally cooled to within 10 to 20 F of the inlet temperature by a heat exchanger on the makeup water line to deaerator.

Boiler-water limits vary with operating pressure

Boiler pressure at outlet, psig	*Total solids ppm	*Alkalinity (Total) ppm	*Suspended solids, ppm	Silica ppm
0-300	3500	700	300	125
301-450	3000	600	250	90
451-600	2500	500	150	50
601-750	2000	400	100	35
751-900	1500	300	60	20
901-1000	1250	250	40	8
1001-1500	1000	200	20	2.5
1501-2000	750	150	10	1.0
2001	500	100	5	0.5

*American Boiler and Affiliated Industries Manufacturers Association's maximum limits for boiler-water concentrations in units with a steam drum

Internal treatment plays a basic role

Treating water in the boiler, while evaporation is taking place, is commonly called *internal treatment*. Aim is to chemically adjust or balance boiler water to prevent scale formation, corrosion, steam contamination, embrittlement. Some form of this treatment is given to practically every boiler. Amount and type of chemicals depends on plant operating conditions and feedwater analysis.

Feedwater analysis in turn varies with raw-water makeup and type of external treatment it's given. This ranges from nothing at all to complete removal of solids. But in all cases internal treatment, using standard equipment with readily available chemicals, is necessary. Long term trouble-free operation also demands regular control tests of feedwater, boiler water, steam and condensate returns. Therefore, carefully scrutinize claims made for "cure-all treatments," "magic formulas" and "spectacular gadgets" before changing your present treatment methods.

Now let's see what happens to scale-forming salts of calcium and magnesium in the boiler. Every internal treatment is designed to precipitate these salts in the most desirable form. This removes hardness but produces an equivalent amount of suspended solids or sludge that is potentially troublesome, but controlled by blowdown. Mechanical attachment of these suspended solids to heating surfaces is one cause of scale inside the boiler.

Amount of suspended solids that can be tolerated depends mostly on operating pressure and load conditions, and may even control boiler blowdown. But when potential sludge in the feedwater is excessive, external treatment enters the picture to soften makeup supply or otherwise reduce dissolved solids. Low-pressure boilers usually permit higher sludge concentrations than are allowed for most high-pressure installations.

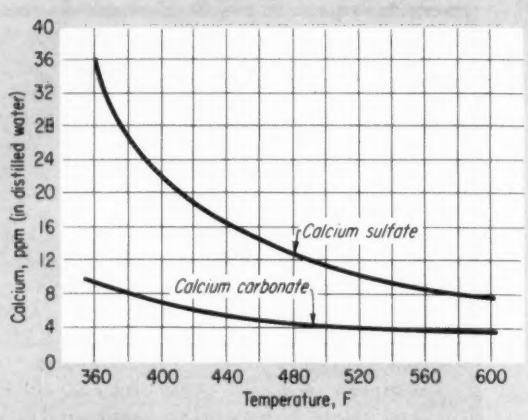
Organic materials such as tannins, lignins, starches and seaweed derivatives should also be used to keep boiler sludge fluid. There are several different ways that organics hinder scale formation. Some coat crystal particles such as calcium carbonate, above, with a protective layer of colloidal material. This prevents precipitated particles from sticking to each other or to the boiler-drum surfaces.

Other organic colloids, such as sodium mannuronate and sodium alginate, react with calcium and magnesium salts to form a floc that entangles precipitates. Organics also distort crystal formation to inhibit scale deposits at point of formation. While these materials solve many problems in low- and medium-pressure boilers, they are not widely used at very high pressures and temperatures.

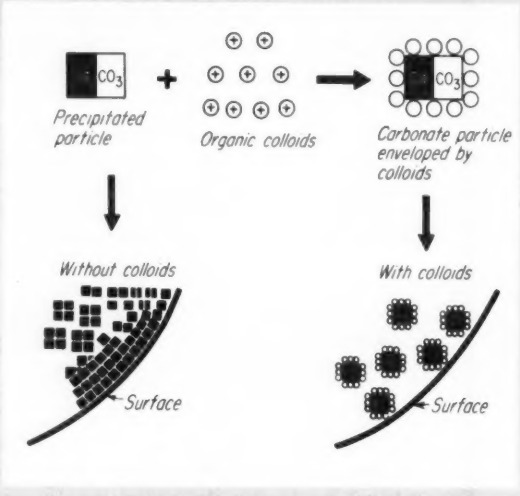
Phosphate treatment to cut calcium in the boiler is almost standard practice for low-hardness feedwater. Forms commonly used include monosodium (acid), disodium (about neutral), trisodium (alkaline) and many complex phosphates. Choice in each case depends upon economics and alkalinity of the boiler water. Once they enter the boiler their reactions are similar. Calcium hardness comes down as a flocculent phosphate precipitate when enough alkalinity is present for the reaction to take place.

Calcium isn't precipitated properly below a pH of 9.5. So it's necessary to select a phosphate that adjusts pH to the optimum value. This may call for blending two of them together or adding an alkali. The phosphate precipitate will be either tricalcium phosphate or hydroxyapatite, $Ca_{10}(OH)_2(PO_4)_6$, if hydrate content of boiler-water reaction zone is high enough. Preferred form is the hydroxyapatite (mixed phosphate and hydroxide) precipitate because it's less sticky than tricalcium phosphate. Caustic

Organics keep the precipitates fluid



CALCIUM SULFATE is usually more soluble than carbonate making it simple to chemically prevent calcium sulfate scale



CALCIUM CARBONATE precipitated by boiler heat or soda ash forms a sticky sludge unless some colloidal material is used

Wide variety of chemicals adjust boiler-water analysis

Chemical	Purpose	Comment
Sodium hydroxide NaOH (caustic soda)	Increase alkalinity, raise pH, precipitate calcium sulfate as the carbonate	Contains no carbonate, so doesn't promote CO_2 formation in steam
Sodium carbonate Na_2CO_3 (soda ash)	Increase alkalinity, raise pH, precipitate magnesium	Lower cost, more easily handled than caustic soda. But some carbonate breaks down to release CO_2 with steam
Sodium phosphates NaH_2PO_4, Na_2HPO_4, Na_3PO_4, $NaPO_3$	Precipitate calcium as hydroxy-apatite $[Ca_{10}(OH)_2(PO_4)_6]$	Alkalinity and resulting pH must be kept high enough for this reaction to take place (pH usually above 10.5)
Sodium aluminate $NaAl_2O_4$	Precipitate calcium, magnesium	Forms a flocculent sludge
Sodium sulfite Na_2SO_3	Prevent oxygen corrosion	Used to neutralize residual oxygen by forming sodium sulfate. At high temperatures and pressures, excess may form H_2S in steam
Hydrazine hydrate $N_2H_4 \cdot H_2O$ (35% solution)	Prevent oxygen corrosion	Removes residual oxygen to form nitrogen and water. One part of oxygen reacts with three parts of hydrazine (35% solution)
Filming amines Octadecylamine, etc	Control return-line corrosion by forming a protective film on the metal surfaces	Protects against both oxygen and carbon dioxide attack. Small amounts of continuous feed will maintain the film
Neutral amines Morpholine, cyclohexylamine, benzylamine	Control return-line corrosion by neutralizing CO_2 and adjusting pH of condensate	About 2 ppm of amine is needed for each ppm of carbon dioxide in steam. Keep pH in range of 7.0 to 7.4 or higher
Sodium nitrate $NaNO_3$	Inhibit caustic embrittlement	Used where the water may have embrittling characteristics
Tannins, starches, glucose and lignin derivatives	Prevent feed line deposits, coat scale crystals to produce fluid sludge that won't adhere as readily to boiler heating surfaces	These organics, often called protective colloids, are used with soda ash, phosphate. Also distort scale crystal growth, help inhibit caustic embrittlement
Seaweed derivatives (Sodium alginate, sodium mannuronate)	Provide a more fluid sludge and minimize carryover	Organics often classed as reactive colloids since they react with calcium, magnesium and absorb scale crystals
Antifoams (Polyamides, etc)	Reduce foaming tendency of highly concentrated boiler water	Usually added with other chemicals for scale control and sludge dispersion

alkalinity also precipitates magnesium salts as the extremely insoluble magnesium hydroxide.

Carbonate-organic treatment still finds use in many low-pressure boilers. If sufficient alkali is already present in the feedwater to precipitate the hardness the water is called *self-purging*. Then additional alkali isn't required although organics are needed for sludge conditioning. But soda ash usually must be added to avoid calcium sulfate scale by precipitating the more insoluble calcium carbonate. Curves, facing page, show theoretical relationship of solubility with increasing temperature.

Carbonate-organic method is often more economical on relatively high hardness (60-70 ppm) and high-alkalinity water. Resulting sludge is easier to handle than phosphate type. Conversely, phosphate treatment does a better job on low-hardness waters and can handle higher temperatures and pressures. Soda ash must be used with care since it breaks down under boiler heat and pressure to form hydroxide alkalinity and carbon dioxide which goes off with the steam to promote return-line corrosion. The carbon dioxide dissolves in the condensate to form carbonic acid. This lowers pH and greatly accelerates the rate of oxygen corrosion. Table, above, includes chemicals in common use to control corrosion in boiler and return lines.

Boiler pressure is big factor in choice

In general, as boiler pressures increase, improved feedwater quality is required. Low-pressure boilers are often able to use raw-water makeup with only internal treatment. High-pressure boilers at the other end of the scale may require almost complete removal of all dissolved solids from the makeup. And there are all degrees of feedwater treatment for boiler pressures that fall between these extremes.

But by classifying boilers simply as low, medium and high pressure we can cover the types of treatment most commonly used in each of these areas. Of course, there are always exceptions and special cases that will not fit this general pattern. But even these can be more intelligently handled by using this broad classification of treatment as a starting point.

For purposes of this report let's fix the low-pressure range at 0 to 125 psig. Medium-pressure class will have an upper limit of about 750 psig. This is highly variable since many feel that anything over 600 psig should be called high pressure. Others believe that anything less than 900 psig is still medium pressure. High-pressure class will cover all those boilers operating above this middle range.

Low-pressure plants need external treatment when water analysis and operating conditions indicate that suspended solids in the boiler will be too high. When practical, always include a deaerator in the feedwater cycle to remove dissolved oxygen and CO_2.

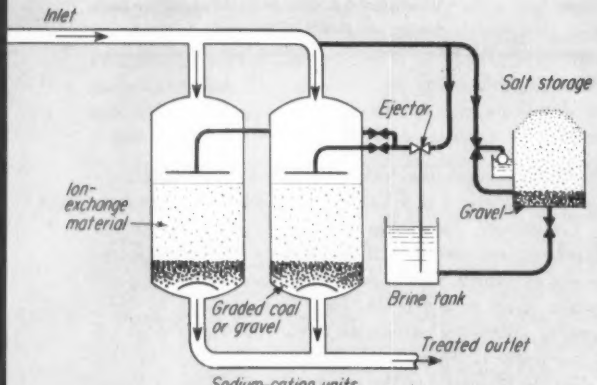
When makeup is low, say 20% or less on a 20,000-lb-per-hr boiler, internal treatment is a good bet to handle the job alone. But call in a feedwater treating specialist to recommend type and amount of chemicals and controls needed. Generally, phosphate treatment is used. Enough phosphate is fed to reduce boiler-water hardness to zero and maintain a phosphate residual of 30 to 60 ppm. Adjust hydroxide alkalinity with caustic soda to 100 to 300 ppm level. Feed sodium sulfite to chemically scavenge any dissolved oxygen from the feedwater and keep a residual of 20-40 ppm in the boiler.

When makeup is high, say 80% or more on a 20,000-lb-per-hr boiler, take a careful look at external treatment. Feedwater hardness is an important factor. If it's less than 25 ppm, internal treatment alone is probably enough with blowdown adjusted to regulate both total dissolved solids and suspended solids. Hardness above 25 ppm usually justifies some kind of external treatment. Type depends on the water analysis.

Low-alkalinity makeup is softened by a simple sodium-cation exchanger. Double unit, below, is often used because it gives a steady flow of soft water at any rate up to the maximum design figure. Also, one complete spare is available for an emergency.

Same job can be handled in a single unit by (1) putting all exchange material needed into one tank (2) increasing softener diameter since a higher rate is needed to treat the same volume of water in two or three hours less time and (3) providing enough softened-water storage to handle the service rate while the softener is off

Ion-exchange softeners are popular for low-pressure boiler-feed makeup



SODIUM-CATION EXCHANGERS are often hooked up in parallel; each unit sized to handle service flow while other is regenerating

Softeners are generally used when percent makeup and raw-water hardness is high. Here's how they are selected:

Assume 100 gpm continuous makeup and total hardness of 171 ppm as $CaCO_3$. Since 17.1 ppm equals one grain per gal (gpg), hardness is 10 gpg. Amount of daily makeup is 100 gpm times 1440 min, or 144,000 gal. In double unit system, left, each softener handles half this, or 72,000 gal. If each is sized to regenerate daily, unit capacity must be 72,000 gal times 10 gpg, or 720,000 gr (720 kgr). Amount of styrene-base cation resin for this, rated at 25 kgr per cu ft (regenerated with 10 lb per cu ft of salt), is 720 kgr divided by 25 kgr per cu ft, or 28.5 cu ft. Maximum unit flow rate of 10 gpm per sq ft requires 10-sq-ft area. Closest unit size is 42 in. dia. Exchanger bed depth is then about 3 ft. With supporting gravel and rising space for backwash, straight height will be 7 ft. Regeneration takes 10 lb per cu ft of salt times 28.5 cu ft or 285 lb. Amount per 1000 gal of softened water is 285 divided by 72,000, or 3.96 lb. Salt-storage tank should hold enough for ten or more regenerations of the sodium-cation exchangers.

# of treatment

the line for its brine regeneration.

Phosphate internal treatment will remove the residual hardness. Add sodium nitrate for embrittlement control. Watch pH of condensate carefully. Either neutralizing or filming amines can be used to guard against return-line corrosion. Since sludge won't be a big problem, adjust blowdown to control alkalinity and total dissolved solids. Hold phosphate, sulfite and hydroxide alkalinity residuals at about the same levels as before.

High alkalinity makeup should be treated to reduce the bicarbonate in addition to being softened. Available systems are shown at right. Selection is based mainly on water analysis and the magnitude of flow. Simplest method is a softener followed by a chloride anion exchanger. Treated water is soft and low in alkalinity. But resulting chlorides may be excessive if raw water is high in sulfates, nitrates and bicarbonates. Other methods shown are capable of doing an even more complete job of alkalinity reduction. But complexity and cost often limits their application to larger plants where trained operators are more readily available.

This external system is then followed up with internal phosphate treatment. Sodium nitrate isn't usually required. But a supplemental feed of caustic soda is needed to adjust boiler water hydroxide and pH. Blowdown is based on total dissolved solids.

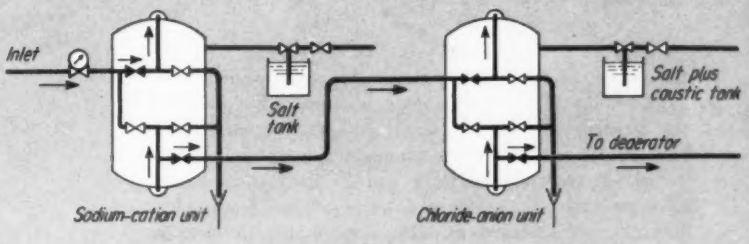
Medium-pressure boilers — both power and process — need extensive makeup water treatment. Complete deaeration of the feedwater is a must. Degree and type of treatment system will vary with percent makeup, water analysis and overall economics.

Let's take a hypothetical case where boiler capacity is in the range of 100,000 to 500,000 lb per hr at 600 psig. Amount of makeup is 40% and raw water is high in hardness, alkalinity, silica. Turbidity is low.

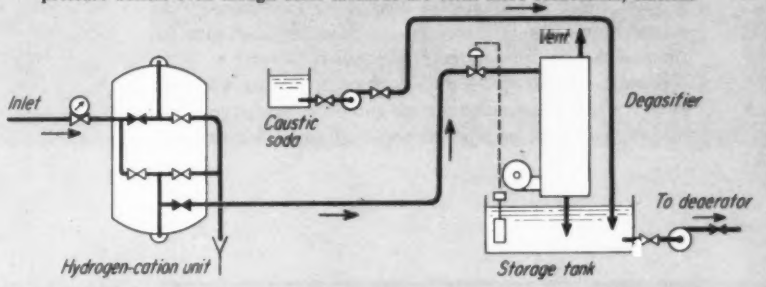
Hot-lime-zeolite treatment is the first possibility. Bulk of the silica is removed when dolomitic lime or magnesium oxide is fed to the settling tank. Alkalinity is also reduced and hardness practically eliminated in the

Potential CO_2 in steam and condensate is cut by reducing raw-water alkalinity

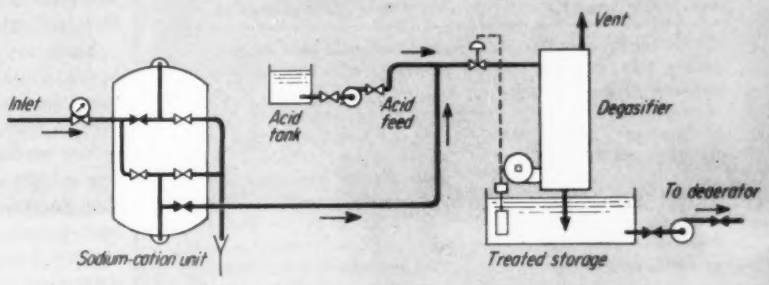
Under boiler pressure and temperature, each ppm bicarbonate alkalinity liberates 0.79 ppm CO_2; each ppm carbonate 0.35 ppm CO_2. Carried over with steam, CO_2 dissolves to form carbonic acid in condensate. With dissolved oxygen it severely corrodes the return lines. Here are four simple ways to reduce alkalinity, get rid of most CO_2. Hot-process units, covered later, also do a good job.



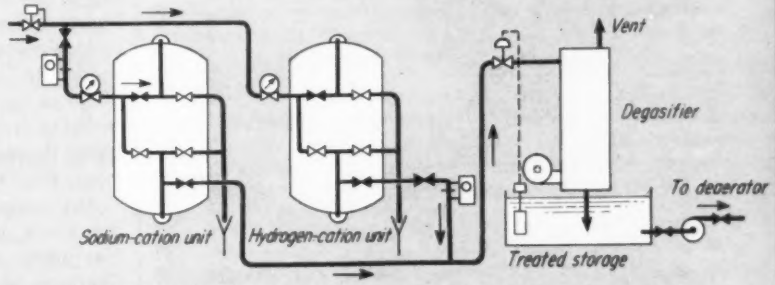
CHLORIDE-ANION EXCHANGER after softener drops alkalinity 80 to 90% using salt and caustic (optional). Since acid isn't required, it's favored for low-pressure boilers even though other methods are often more economical, efficient



HYDROGEN-CATION UNIT destroys all bicarbonate, carbonate alkalinity. Resulting CO_2 is reduced to range of 2 to 15 ppm in degasifier or deaerator. Caustic-soda feed then neutralizes mineral acidity, raises pH to desired level



ACID FEED after softener reacts with bicarbonate and carbonate alkalinity to form CO_2. Degasifier CO_2 residual is in 2 to 15 ppm range. Control of acid feed is critical for good results. Caustic is usually added later to raise pH



SPLIT-STREAM DEALKALIZER blends water from hydrogen, sodium units for 10 to 15 ppm alkalinity. Degasifier reduces CO_2. Proportion through hydrogen unit about equals alkalinity reduction divided by total cations (as $CaCO_3$)

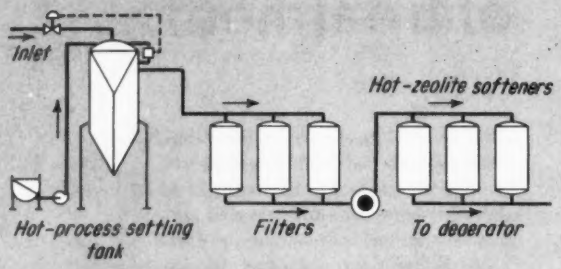
Hot-lime-zeolite plants and demineralizers vie for makeup to medium-pressure boilers

sodium-cation exchangers. Supplementary internal treatment usually includes phosphate, sodium sulfite, organics and possibly an antifoam. Control blowdown rate to keep boiler-water silica below recommended limit of 50 ppm.

Split-stream dealkalizer can be used if raw-water silica isn't too high. Treated water is soft and low in alkalinity. Supplementary internal treatment is about the same except that caustic soda is called for to control alkalinity and pH of both feedwater and boiler water. Calculate the amount of blowdown needed to limit boiler-water silica to 50 ppm. Since this treatment doesn't reduce silica, the required blowdown rate may be too high. In that case another method is needed to reduce silica.

Caustic regenerated-anion exchanger merits attention when the raw-water silica is high and other dissolved solids are low. This unit usually follows a sodium-cation softener.

Hot process handles turbid water,



HOT LIME-ZEOLITE produces treated water with 0 to 2 ppm hardness, 20 to 30 ppm alkalinity and 0.5 to 1.0 ppm silica. Moderate blowdown usually keeps boiler-water silica in 5 to 25 ppm range. Boilers and turbines are protected from carryover, scale and silica deposits. Low carbonate alkalinity means low CO_2 in the steam

CHARACTERISTICS. Hot-process settling tank handles turbid waters. Resin used in the hot-zeolite softener is stable and replacement costs are reasonable. Chemical operating costs and initial investment are low compared to demineralizing. Lime and salt are easily handled. Settling tank reactions require careful chemical control

Hot-process units use these chemicals

Raw-water analysis	Chemicals and application
(1) Hardness greater than alkalinity. Both carbonate, noncarbonate hardness present	Lime and soda ash for low-pressure boiler-feed makeup treatment
(2) Same as (1) except that boiler pressure is higher	Lime and soda ash followed by supplementary phosphate to boiler or boiler-feed pump
(3) Same as (1) except that boiler pressure is higher in the medium-pressure range	Lime followed by hot-zeolite softeners. Salt regeneration is more economical than soda ash or phosphate. Produces lower hardness and alkalinity
(4) Contains carbonate and noncarbonate hardness in the proper ratio	Caustic soda to react with carbonate hardness with the resulting carbonates precipitating noncarbonate hardness
(5) Alkalinity much higher than hardness. Sodium bicarbonate is present	Feed lime and gypsum. The gypsum converts sodium bicarbonate to sulfate
(6) Same as (5)	Sulfuric acid to convert sodium bicarbonate to carbonic acid and sodium sulfate, followed by lime
(7) Silica	Feed dolomitic lime, activated magnesium oxide, epsom salts, ionic magnesium
(8) Oil, organic matter and turbidity	Lime and soda ash with coagulants or coagulant aids

Chlorides, sulfates and bicarbonates in the softener outlet are exchanged for hydroxides. Silica is actually absorbed in the process. Type of water best suited for this treatment will probably have silica of more than 20 ppm with total dissolved solids (other than silica) less than 200 ppm.

Since any bicarbonate in the raw water is converted to hydroxide, carbon dioxide in steam is reduced to a minimum. In fact, depending on the analysis, it may be necessary to reduce the hydroxide alkalinity with an acid feed before sending it to the boiler. Operating cost of this system is higher than for hot lime-zeolite, but probably lower than demineralizing. Total investment on an erected basis may be less than demineralizing or hot lime-zeolite. Assuming comparable treated-water quality, economics will determine whether the savings in fixed charges over hot lime-zeolite will counterbalance the higher operating cost.

Demineralizing produces better makeup water than any of the methods discussed so far. Main drawback is higher equipment and chemical operating cost. Advantages include reduced boiler blowdown and a big assist for the production of higher-quality steam. This is why more plants in the medium-pressure range are going to demineralizing systems. But it's hard to justify demineralizing unless the plant is at the high end of the medium-pressure range and the raw water is low in total dissolved solids.

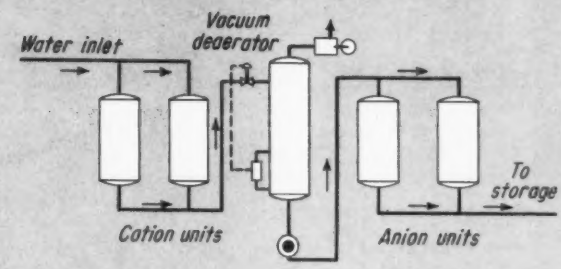
Any comparison between hot process and demineralizing, above, is greatly affected by the raw-water analysis. Hot-process settling-tank size varies primarily with flow. Character of the water changes the type and amounts of chemicals used. These are shown, left, in tabular form. So physical size and, therefore, equipment cost is not greatly

while demineralizers usually require some form of pretreatment

Size of hot-process settling tank, left, is based on flow rate and a standard detention time of 60 to 90 minutes. Raw-water analysis affects only amount and type of chemicals fed to get desired results. Chart, facing page, lists those that are commonly used.

In demineralizing system, right, water analysis has a direct bearing on equipment size. Quantity of ion-exchange materials, as well as chemical operating costs, increase as total dissolved solids in the water go up. Equipment cost for hot process varies almost directly with raw-water flow. But in a demineralizing plant total dissolved solids also affect overall cost. This helps to explain why a demineralizer may compare favorably with hot process in one case and be completely out of the question in another where conditions are essentially the same except for water analysis.

First step in sizing a demineralizer is to compute total exchangeable anions and cations. Start with the anion units using the approach outlined for zeolite softeners on page 74. Then size cation units adding extra capacity for backwash, rinse and chemical dilution used in anion regeneration. This will give you an idea of size and operating cost for comparison with alternate water-treatment methods.



DEMINERALIZING produces top-quality makeup of type demanded by high-pressure boilers. Dividing line for high and medium pressure, as far as water treatment is concerned, falls between 750 and 1250 psi. But many medium-pressure units will continue using demineralized makeup to get purer steam, reduced blowdown, etc

CHARACTERISTICS. Treated water has about 3 ppm total dissolved solids and 0.1 ppm silica. System can be made automatic. Boiler blowdown is reduced, but chemical and installed equipment cost will probably be higher than other methods. Pretreatment is needed to remove turbidity. Anion resins have short life on some waters

affected by variations in the raw water. But in the case of a demineralizing system, water analysis has a direct bearing on both equipment size and the chemical operating cost.

Turbidity of water supply is another important factor in treatment selection. The hot-process tank can handle fairly high turbidity from the incoming water. But ion-exchange systems such as demineralizing cannot tolerate more than 5 to 10 ppm turbidity. So they often need pretreatment. It's also a must to help remove organic substances that foul anion exchangers.

Pretreatment may consist simply of a battery of filters to remove moderate amounts of turbidity. More often it involves a complete coagulation, clarification and filtration plant. Then it may pay to use a cold-process softener that reduces hardness and alkalinity while it is removing turbidity. Depending on the water, this can greatly reduce the load on ion-exchange equipment.

Unless the clarification equipment is needed for other purposes such as treatment of cooling or process water the additional investment charges are usually high enough to make most economic comparisons favor the hot-lime-zeolite process in the medium boiler-pressure range.

High-pressure boilers require the most exacting feedwater treatment. Upper limit to this class has been increasing steadily. Not too long ago it went over 2000 psig and now is well up into the supercritical-pressure range.

Main impurity receiving critical attention is silica. At high pressures silica in boiler water volatizes and passes over with steam to the turbine. As steam expands through the turbine this silica deposits on the blades. This cuts

Here's how to figure hot-lime-soda chemical needs

Although the hot-process softener is more conveniently controlled by testing the treated water, chemical needs for lime and soda ash can be readily calculated from the analysis of the raw water. Let:

(1) TH = Total hardness, ppm as $CaCO_3$
(2) Alk = Total alkalinity, ppm as $CaCO_3$
(3) Mg = Magnesium hardness, ppm as $CaCO_3$

These equivalent weights will be used:

(1) Calcium carbonate = 50
(2) Calcium hydroxide, 90% = 41.1 (lime)
(3) Sodium carbonate = 53 (soda ash)

Now assume that the raw water has a total hardness of 150 ppm, total alkalinity of 125 ppm and a magnesium hardness of 50 ppm, all expressed as $CaCO_3$. Amount of lime used is then:

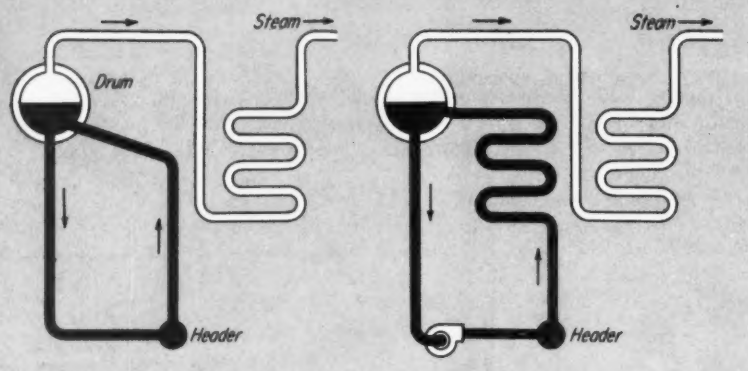
$$\frac{(Alk + Mg)}{50}\ 41.1 = \frac{(125 + 50)}{50}\ 41.1$$

or 143.8 ppm equivalent to 1.2 lb per M gal. Amount of soda ash called for is:

$$\frac{(TH - Alk)}{50}\ 53 = \frac{(150 - 125)}{50}\ 53$$

or 26.5 ppm equivalent to 0.22 lb per M gal. Add to this the excess carbonate needed.

Upper limit of high-pressure boiler category



NATURAL-CIRCULATION boilers are used successfully for pressures below 2800 psig

CONTROLLED-CIRCULATION boilers with circulating pumps are used above 2000 psig

High-pressure and once-through boilers call for feedwater

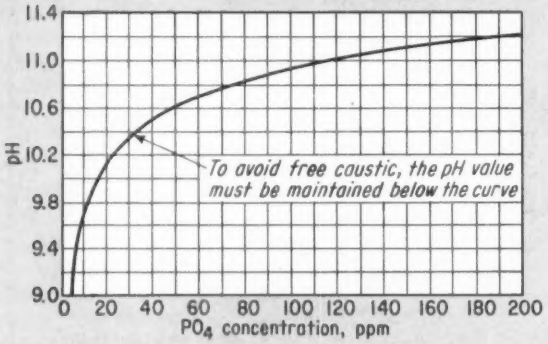
efficiency and eventually the turbine must be shut down for thorough cleaning to remove these deposits.

So as boiler pressures increase, silica level in boiler must be carefully watched to minimize amount of volatized silica in steam. Curve, facing page, indicates range of silica in boiler water to keep silica in steam below the 0.02 to 0.03 ppm level.

Total dissolved solids allowed in a boiler also drop off sharply at higher operating pressures. However, silica generally controls blowdown at upper end of pressure scale, with resulting solids level somewhat lower than the maximum allowed.

External treatment under these conditions is limited to either evaporation or demineralizing. Both produce top-quality makeup, facing page. There are many factors that influence each decision to use one or the other method in a given plant. Supplementary internal treatment falls into two general categories. Both use blowdown to keep silica and dissolved solids below maximum limits, and both keep 3 to 5 ppm sodium sulfite and a slight excess of hydrazine or both in the boiler. The first is known as the low-caustic method. Hydroxide alkalinity is kept at about 5 ppm with 3 to 5 ppm phosphate expressed at PO_4. Second method, called "Coordinated pH phosphate control," is outlined below. Phosphate alkalinity is carried in the range of 20 to 100 ppm by adjusting pH so there isn't any free caustic present.

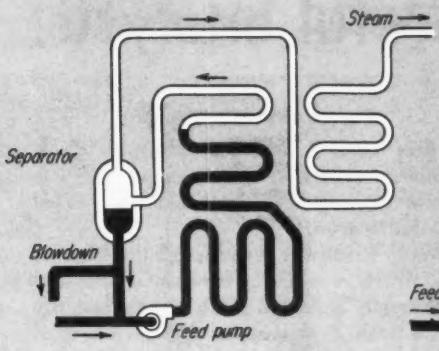
Coordinated phosphate pH control protects against caustic attack



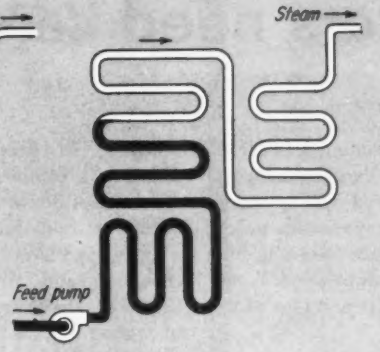
PHOSPHATE and pH of boiler water are controlled simultaneously so boiler pH is always equal to or less than the value on the curve

This control method aims to produce boiler water that won't concentrate caustic on evaporation and will contain enough alkalinity to give corrosion protection. This is done by keeping only bonded alkali-metal phosphate in the boiler water. Without caustic there can't be caustic attack in the boiler. Any alkaline attack has to come from the relatively weak phosphate alkalinity. Graph, left, is used for control. Plot pH and phosphate concentration of the boiler water on the grid. If this point falls on the curve, all phosphate is in trisodium form. If it falls above the curve, free caustic is present in the boiler. If it falls below the curve, acid phosphate salts are present. When this happens and phosphate content is at desired maximum, add enough sodium hydroxide to increase pH and bring this point back on the curve. All the phosphates are then in trisodium form.

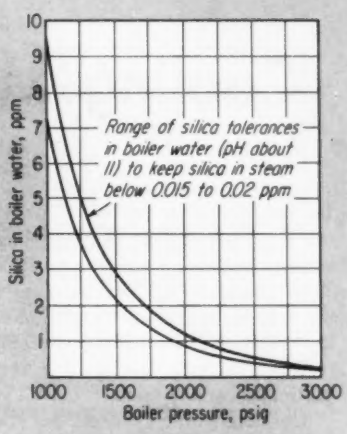
stretches well into the supercritical range



ONCE-THROUGH design for subcritical pressures may include a water separator



SUPERCRITICAL PRESSURE, once-through boilers don't have any drum or separator



ALLOWABLE SILICA in boiler water rapidly drops with rising boiler pressures

that's extremely low in silica and dissolved solids

Supercritical pressure once-through boilers pose many special treatment problems. Since there isn't any boiler drum, above, all water entering the circuit passes out as supercritical fluid. Any solids present in the feedwater are carried off with the steam. These leave troublesome deposits in the superheater or turbine. Since feedwater is the same as boiler water, these limits in parts per billion apply to both: (1) Total dissolved solids, 50 to 500 ppb; (2) silica, 20 ppb; (3) iron, 10 ppb; (4) copper, 10 ppb; (5) oxygen, 5 to 7 ppb; (8) pH in the range of 9.0 to 9.6.

There are two general sources of impurities that enter the cycle and cause trouble with deposits. The first is mineral impurities in the condensate, usually coming through the condenser from the cooling water. Second is metal oxides from preboiler corrosion. Improvements in condenser design and manufacture are expected to cut leakage from this source to a minimum. But it's still good practice to treat all or part of the condensate stream by sending it through a polishing mixed-bed demineralizer. Total dissolved solids are reduced below 0.04 ppm and silica is taken below 0.01 ppm. Vapor type chemicals rather than solid type are used for supplementary treatment. Both hydrazine and ammonia are typical vapor type chemicals used for oxygen scavenging and corrosion control in the preboiler cycle of today's high-pressure plants.

Evaporators and demineralizers produce top-quality water

Demineralizers and evaporators are used to supply makeup water for today's high-pressure boilers. Demineralized-water quality depends on the type of system used. Conductivity may be in the range of 0.5 to 1.0 micromhos with silica less than 0.02 ppm. Recent tests of vapor purity from evaporators, using sodium tracer techniques, consistently report less than 0.01 ppm total dissolved solids.

Before deciding on one method or the other make an economic comparison of both systems. This study should include: (1) installed equipment cost; (2) investment charges; (3) value of evaporator heat-loss or energy degradation; (4) chemical operating cost; (5) labor and maintenance charges. Outcome of this study will vary with each individual case. Amount of total dissolved solids in the water will greatly affect size and chemical operating cost of the demineralizer. Water analysis will also determine kind of evaporator pretreatment needed. Plant heat balance will fix value of heat or energy loss when steam in evaporator coils is degraded to lower pressure.

Intangibles merit attention too. A demineralizing plant has the advantage of being able to produce high-quality water when heat isn't readily available. This is valuable for starting up new power plants and supplying makeup for older power plants now operating at light loads. Evaporator output is closely tied to the plant heat cycle, but the demineralizer can give rated capacity whenever needed. Mixed-bed demineralizers also look promising for polishing service in condensate cycles to remove trace impurities.

Evaporators generally have a consistent record of reliable, trouble-free performance. Their operating problems are usually traceable to poor or no pretreatment of makeup or insufficient capacity. Demineralizers also have their share of operating problems, ranging from resin fouling to trouble with complicated automatic controls.

Cooling waters need careful analysis,

Industry probably uses more water for cooling than for all other purposes combined. Condensers, heat exchangers, cookers, engines, compressors, etc all need cooling water. Thus cooling-system maintenance can be very costly unless the water is treated to (1) prevent corrosion, deposits, biological growths and (2) protect cooling-tower wood. Water treatment, in turn, is tailored to fit the size and type of the particular cooling system.

Cooling-water systems are broadly divided into two main types — *once through* and *recirculating*. In the once through system cooling water makes one pass through the heat-exchange equipment. No evaporation takes place; water temperature is merely increased about 20 F. Since the water is eventually discharged to waste, its use is limited to areas with an abundant water supply.

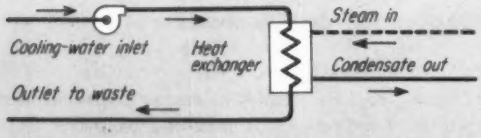
Trend is toward the more complex recirculating systems where water is saved by continuous re-use. In the open recirculating type a cooling tower or spray pond cools water by evaporation. Only water losses are from evaporation, windage and blowdown. But treatment problems are more critical because solids are concentrated and water aerated in towers or spray ponds. Closed-recirculating system avoids these troubles by using a fan-cooled radiator or closed heat exchanger cooled by water in a secondary circuit. Water loss is at a minimum and solids are not concentrated. In effect major treatment problems are transferred to a secondary system where the temperature rise can be kept down. These combination hookups are called double-recirculating systems.

Open type is most frequently used for cooling water in chemical plants, oil refineries and power-plant condensers. Closed system is usually limited to uses where the quantity of cooling water is small. Typical applications include compressor and diesel-engine cooling.

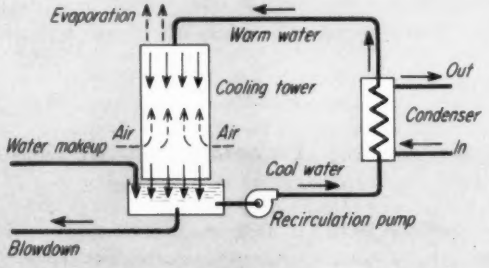
Calcium-carbonate scale is the most common type of water-formed deposit in cooling systems. Calcium bicarbonate, naturally present in all raw water, breaks down to form relatively insoluble calcium carbonate. As water temperature rises it becomes even more insoluble.

Langelier Index measures the tendency of calcium carbonate to precipitate from water under given conditions of calcium hardness, alkalinity, pH, temperature and total dissolved solids. Charts, nomographs and special slide rules can be used to quickly calculate this index for any water supply when the complete analysis is known. It equals the pH of the water, minus pH of saturation of calcium carbonate. Positive index means water has a tendency to deposit scale while a negative index shows a tendency to dissolve scale and corrode. Note that the index doesn't measure amount or rapidity of scaling. This depends on amount

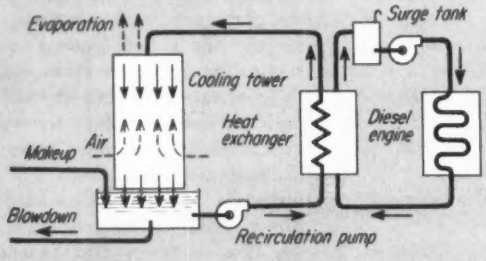
Treatment selected depends largely on the type of cooling-water system employed



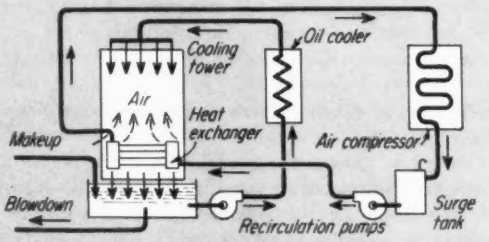
ONCE-THROUGH SYSTEM calls for ample supply of cooling water. The discharge can often be re-used for boiler makeup, process, etc



OPEN-RECIRCULATING HOOKUP makes use of cooling tower or spray pond to cool water by evaporation. Water can then be re-used



DOUBLE-RECIRCULATING DESIGN combines an open and a closed system. Water passing through closed circuit does primary cooling



RECIRCULATING WATER passing through the closed circuit is often cooled by a heat exchanger in the bottom of the cooling tower

chemical control

of calcium carbonate actually present in each water supply.

Reducing the calcium hardness, total alkalinity and pH or a combination of all three will decrease index of the water. Total dissolved solids content has a relatively minor effect. Blowdown, right, is one way of reducing concentration of calcium and alkalinity in recirculating water. But this increases makeup and is seldom used as the only method of control.

External-treatment methods used to adjust analysis of cooling water include: (1) Cold-process softening with lime followed by an acid feed to adjust pH, alkalinity. (2) Ion-exchange softening with hard-water bypass also followed by an acid feed when needed. (3) Sulfuric-acid feed for moderate hardness waters with high alkalinity.

Stability Index, devised by Ryznar, equals twice pH of saturation of calcium carbonate minus pH of the water. It indicates to what degree a given water is scale forming under average operating conditions. Scale is expected when this index is below six. Amount of scaling increases rapidly as the index approaches four. An index above 6.5 indicates a tendency for the water to corrode.

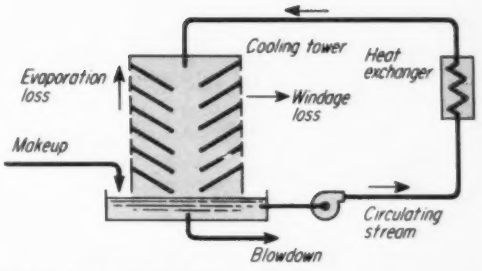
Controlled-scale method adjusts composition of water to insure deposit of a thin impervious layer of calcium-carbonate scale on surfaces of the cooling system. It must be thick enough to prevent any corrosion, but thin enough not to affect overall heat transfer. This approach works well when temperature differential across heat exchangers is low. But when temperature levels vary widely, results are unsatisfactory. If water is adjusted to protect exchangers on high-temperature service, those at lower temperatures will corrode. When control is set for low-temperature applications, high-temperature exchangers will scale. In fact the hot end of an individual exchanger may scale and the cool end corrode with only the center portion receiving adequate chemical protection.

Chemical treatment keeps scale-forming salts of calcium and magnesium in solution by lowering pH of recirculating water with sulfuric acid. Chemical inhibitors are then necessary to prevent corrosion damage.

Surface-active chemicals or chelating agents act to prevent crystal growth and, therefore, scale formation. In effect they increase the solubility limits of the scale-forming salts. This also helps broaden operating range of the controlled-scale treatment. Chemicals in this group include polyphosphates, tannins, lignins, etc. New organic chelating agents show promise.

Corrosion control is provided largely by inhibitors such as chromates, polyphosphates, silicates and alkalies. If doses are high enough either chromates or polyphosphates are effective. But if concentrations are too low, pitting and tuberculation result. Combination treatment with chromate and polyphosphate is most valuable since it gives comparable results with much lower total amounts of chemical. It successfully controls pitting, tuberculation and other metal losses from corrosion. Best results are usually obtained in pH range of 6.0 to 7.5.

Since oxygen and carbon dioxide are primary causes of



COOLING-TOWER EVAPORATION ups solids concentration in recirculating water; blowdown and windage decrease it

How to calculate cooling-tower blowdown

In general the amount of blowdown needed depends on how far the circulating-water dissolved solids are allowed to build up by concentration. Number of concentrations N is one way of comparing dissolved solids in the makeup with that of the circulating cooling-tower water. Since the chlorides remain soluble on concentration, N is conveniently expressed as the ratio of chlorides in circulating water to chlorides in the makeup. System, above, shows the basic items that are part of every cooling-tower system.

C = Water circulating in cooling system, lb per hr
E = Water vapor evaporated from tower, lb per hr
B = Water lost by windage, plus that discharged to waste as cooling-tower blowdown
MU = Makeup water added to system, lb per hr
Cl_C = Chloride content of circulating water, ppm
Cl_{MU} = Chloride content of makeup water, ppm

Makeup water is added to compensate for water losses of evaporation, windage and blowdown:

$$MU = E + B \qquad (1)$$

At equilibrium the amount of chlorides entering and leaving the system must be equal. Amount lost from the system in windage and system blowdown must equal that added in the makeup.

$$MU\ (Cl_{MU}) = B\ (Cl_C) \qquad (2)$$

The number of concentrations N by our definition is $Cl \div Cl_{MU}$. Transposing (2) gives:

$$N = \frac{Cl_C}{Cl_{MU}} = \frac{MU}{B} \qquad (3)$$

Substituting from equation (1)

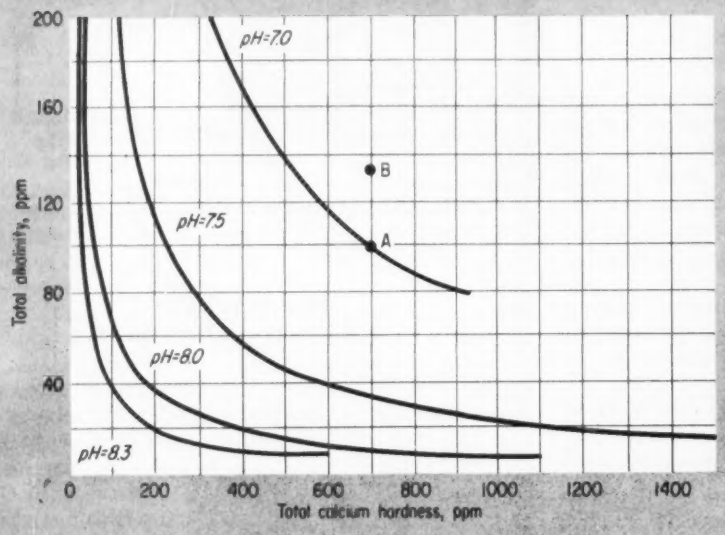
$$N = \frac{E + B}{B} = \frac{E\% + B\%}{B\%}$$

Amount of blowdown needed to limit concentrations in recirculating water is then easily found:

$$B\% = \frac{E\%}{(N-1)} \qquad (4)$$

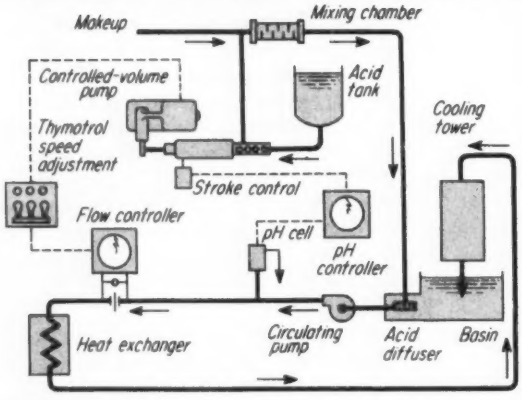
Evaporation loss varies with temperature drop of circulating water. Evaporating one pound of water in the tower absorbs about 1000 Btu's. This will cool 100 lb of water 10 F. So, for each 10 F cooling, about 1% of the circulating water is evaporated. Windage loss varies with type of tower and local conditions. Reasonable estimates are 0.1 to 0.3% for mechanical-draft towers, 0.3 to 1.0% for atmospheric type and 1.0 to 5.0% for systems using spray ponds.

Calcium hardness, alkalinity, pH are related variables in scale control

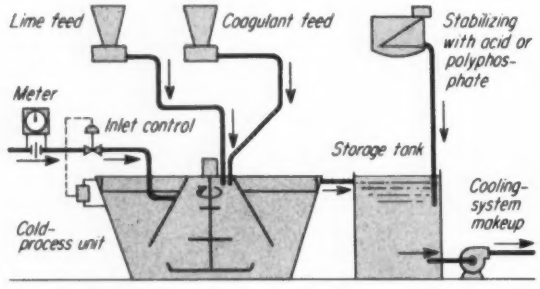


CALCIUM-CARBONATE EQUILIBRIUM conditions (neither scale forming nor dissolving) vary with pH at a given temperature. Values, above, hold only for a temperature of 77 F

Calcium carbonate is one of the most troublesome deposits found in heat-exchange systems. Factors controlling deposition or solution at a given temperature are shown at left. Water with 100-ppm alkalinity, 700-ppm calcium hardness and 7.0 pH will fall on the curve at point *A*. So this water will not precipitate calcium carbonate. Another water with the same analysis, except for 130-ppm alkalinity, will fall at point *B*. Since this point is above the curve, water isn't in equilibrium and calcium carbonate can be expected to precipitate. Area below the curve indicates a tendency for calcium carbonate to dissolve. Water at point *B* is brought back on the curve by reducing hardness or alkalinity. So two waters with the same calcium hardness may have different scale-forming tendencies. Above 77 F, lower pH, alkalinity are needed to avoid deposits.



SULFURIC ACID converts calcium carbonate to the more soluble calcium sulfate. Flow, pH controls automatically adjust amount fed



COLD-PROCESS SOFTENER reduces carbonate hardness with lime. It's most applicable when alkalinity equals or tops calcium hardness

External treatment combines

corrosion, deaeration effectively helps prevent it. Vacuum deaerator units reduce dissolved oxygen below the level of 0.1 ppm, depending on water temperature and equipment design. But relatively high cost has limited its use.

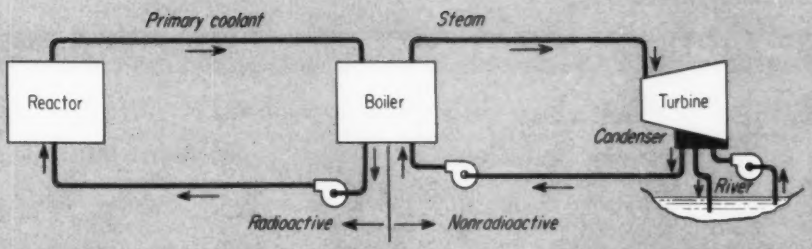
Microbiological growths on heat exchangers retard cooling, cut plant efficiency and up cost of cooling-system maintenance. When any growths suddenly break loose, lines, pumps and heat exchangers may easily clog.

Iron- and sulfur-reducing bacteria are often a direct cause of corrosion. Iron bacteria produce insoluble salts that can be retained on metal surfaces. Differential aeration under these deposits promotes corrosion. Sulfur-reducing bacteria feed on sulfur compounds in the cooling water. Hydrogen sulfide formed also is corrosive.

Algae growths are composed of millions of tiny plant cells that multiply and produce large masses of plant material in a short time. Slime growths are the gelatinous mass of microorganisms that cling to practically all surfaces in the system. There they trap organic matter, debris and scale-forming compounds.

Mechanical cleaning is the most practical way to get rid of accumulated slime and algae growths. After the system is completely cleaned, start in with a good chemical-treatment program to prevent further growth buildup.

Chemicals that prevent slime and algae troubles are



Nuclear-reactor cooling water must be extremely pure

Ample cooling-water supply is a must for nuclear power plants. In a typical pressurized-water reactor, above, water is used for (1) condenser cooling (2) boiler feed and (3) reactor cooling.

Condenser cooling water is treated in normal fashion. But boiler-feed quality must be comparable to that used for very high-pressure boilers.

Cooling water passing through the reactor neutron field becomes radioactive. All water impurities, resulting in residual activity, must be reduced. Cations of manganese, cobalt and sodium are particularly dangerous because they produce energetic gamma rays. Therefore primary cooling-water quality is maintained by treating it with filters and ion exchangers. Both mixed and multibed systems are used to remove and concentrate the radioactive impurities. Although the simplicity of regeneration under remote-control operation favors multibeds, it's often better to discard used resins without regeneration. Then mixed beds are preferred to get the benefit of higher-quality water. If water is badly contaminated, evaporators are best for concentrating impurities for disposal. After cleanup, ion exchangers maintain purity of recirculated water at a lower cost.

with chemicals to combat scale, corrosion, biological fouling

those that are toxic to the microorganisms. Chlorine is fairly general in its toxicity for most bacteria and algae. Residual of 0.5 ppm will destroy most microorganisms. Since chlorine acts on all oxidizable matter, organic material, ferrous iron, etc, overall demand of the water must be satisfied before the needed residual for toxicity can be built up to the desired level.

Chlorine is stable in acid, neutral and alkaline waters. For convenience and economy it is usually fed from a chlorinator in liquid form. Hypochlorite form is best when relatively small quantities are consumed.

Both continuous and intermittent feeds are used. Continuous feeding prevents any buildup of growths, but it's much more expensive than intermittent method. Intermittent or slug feeding runs the risk of allowing growths to build up. Then when they slough off, fouling material in the system increases. Chlorine is usually fed intermittently since overall results are better and cost is lower.

Copper sulfate is toxic to algae, but is less toxic to slimes. Use is limited because it precipitates as carbonate at a pH of 8.5 or over. Phenolic and quaternary ammonium compounds are also used. They resist precipitation at high pH and are not removed by aeration in the cooling tower.

Wood destruction and decay in cooling towers is caused by one or more of the following: (1) chemical attack commonly known as delignification (2) mechanical rupture of wood cells from salt crystallization and (3) biological attack causing wood decay.

Delignification is the removal of tannins, lignins and cellulose products from the lumber, leaving long stringy fibers with greatly reduced strength. It apparently takes place in the presence of high concentrations of sodium carbonate in the circulating water. Oxidizing agents like chlorine tend to speed up the process.

Intermittent splashing on cooling-tower parts produces concentrated salt deposits by evaporation. Salt-saturated water in these areas is absorbed by the wood. Crystals form beneath the surface to disintegrate it mechanically. Result is a mass of soft, loose fibers susceptible to both chemical and biological attack.

Fungus is a form of biological attack caused by microorganisms that feed on wood. These wood-destroying fungi reproduce by spores that alight on the wood surface from the air. Attack is most noticeable in the mist sections and takes place on both wood surface and interior.

Proper control of alkalinity, pH and solids concentration of circulating water will ward off chemical attack. Although it will not prevent biological attack, it will greatly decrease chances of damage from fungus. One good preventive is to use impregnated cooling-tower lumber.

There's a treatment to fit practically every process-water demand

This kind of water-analysis report . . .	. . . points to these process troubles . . .	. . . calling for these treatments
HARDNESS (as $CaCO_3$) .....210 ppm (Calcium and magnesium salts)	Forms scale, wastes fuel and soap; spots, streaks and leaves insoluble film on products and containers	(1) Cold process or cation-exchange softening or both. (2) Can demineralize to remove all dissolved solids
TURBIDITY .....350 ppm	Objectionable for all uses when over the range of 5 to 10 ppm	(1) Settling tanks (2) solids-contact units (3) filters
COLOR 50	Undesirable for beverages and food processing. Discolors products, etc	Coagulate with alum and activated carbon in (1) settling tanks or (2) solids-contact units. (3) Chlorinate
IRON (Fe) .....2.2 ppm Manganese (Mn) .....1.6 ppm	Stains everything it comes in contact with. Fosters growth of clogging, taste and odor-producing bacteria	(1) Cation-exchange softening. (2) Aerate or chlorinate and filter. (3) Aerate, settle and filter. (4) Oxidizing filters
CARBON DIOXIDE (CO_2) .....40 ppm	Promotes corrosion and pitting of piping and equipment	(1) Deaerate or degasify. (2) Adjust the pH. (3) Use corrosion inhibitors
ALKALINITY (as $CaCO_3$) .....175 ppm	Cuts tang in soft drinks, interferes with brewing of light beers	(1) Cold-process softening (2) ion-exchange dealkalizing or (3) demineralizing to remove all dissolved solids
TASTE AND ODOR .....Trace	Affects food processing, beverages, pulp and paper products, etc	(1) Aerate or degasify. (2) Chlorinate. (3) Activated carbon filters

Process-water treatment varies

Practically all process waters should be noncorrosive and free of turbidity, color, iron, manganese and hydrogen sulfide. Microbiological growths, tastes and odors are also objectionable. Limits for each of these items depend on the process, but are generally in agreement with tolerances outlined in Part I of this report (POWER, December 1958). Chart, above, shows type of treatment given.

Hardness must be removed or reduced in a wide variety of process, wash and rinse waters. Water with enough calcium alkalinity will form scale when heated, boiled or concentrated. Result: clogged heat exchangers, pipelines, fixtures, nozzles. Scale in processing tanks may come off in chunks during operation. Processed materials are often spotted, streaked or covered with insoluble films.

Hard water also reacts with soda ash, caustic soda, sodium phosphate, sodium silicate, hydrated lime, ammonia and soap. This wastes the chemical and forms precipitates that lower product quality by adhering to processed material. Hard water is very undesirable in all washing and scouring involving soap since bulky, sticky, insoluble calcium and magnesium soap curds are formed.

Emulsions are difficult to make with hard water since divalent calcium and magnesium ions have a tendency to break emulsions. Clay processing is also affected since these same ions produce a coagulating effect that lowers plasticity of the mix.

Electroplating cleansing and rinsing should be done with softened water to avoid precipitates in alkaline baths and prevent calcium-sulfate deposits in acid baths. Mineral-free water helps avoid product streaking.

Beverage water must be completely sterile to prevent spoilage, crystal clear for appearance and good carbonation, free of tastes and odors, uniformly low in alkalinity. Fermentation processes such as brewing light-colored beers require low calcium, magnesium alkalinity.

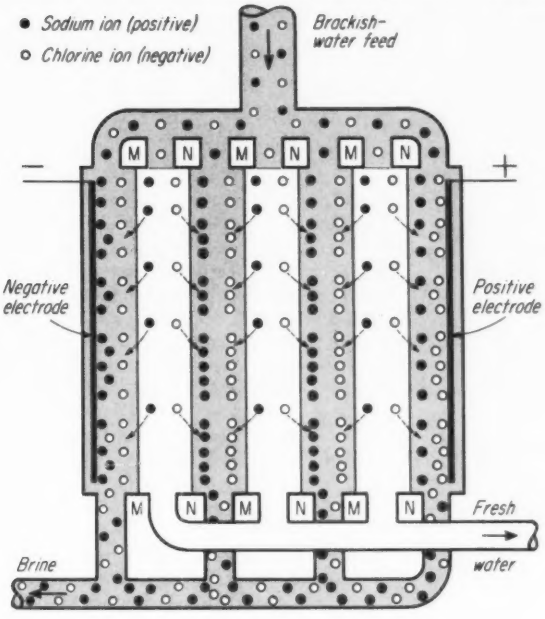
Pulp and paper processes need water with little or no color, iron or manganese. Highly colored water affects white and dyed papers as well as pulps. Cellulose fibers readily absorb color and the stain may remain in the finished product. They also absorb iron from dilute solutions to yellow-white pulp or paper and dull-colored paper. Taste and odors may also be picked up by cellulose.

Oil-field flooding operations must keep pores of the ground clear to pass enough water for successful repressurizing. So water must be noncorrosive, stable and free from turbidity, iron, manganese, bacterial action.

Cation-exchange softening is the most widely used method of removing hardness. Next is cold process using lime only or lime and soda ash. This treatment is particularly good where some degree of partial softening is sufficient. Carbonate hardness can be reduced to the range of 35 to 70 ppm. Often reducing calcium hardness to 35 ppm is all that's needed.

Filters are widely used for turbidity removal. They may handle it alone or follow a clarifier or a cold-process

Electrodialysis method is newcomer for brackish-water supplies



Electric charges of ions dissolved in water help remove solids from solution. Here's how: Sodium chloride dissolves to form sodium ions with a positive electrical charge and chlorine ions with a negative charge. Positive electrode immersed in this solution will attract chlorine ions and a negative electrode attracts the sodium ions.

Combining this action with ion-selective membranes that allow only one type of ion to pass through gives a method of removing dissolved solids from water. Membrane cell, left, shows how this works. Practical units will contain about 300 membranes and work best on brackish waters. This relative newcomer can reduce solids from 4000 to 350 ppm.

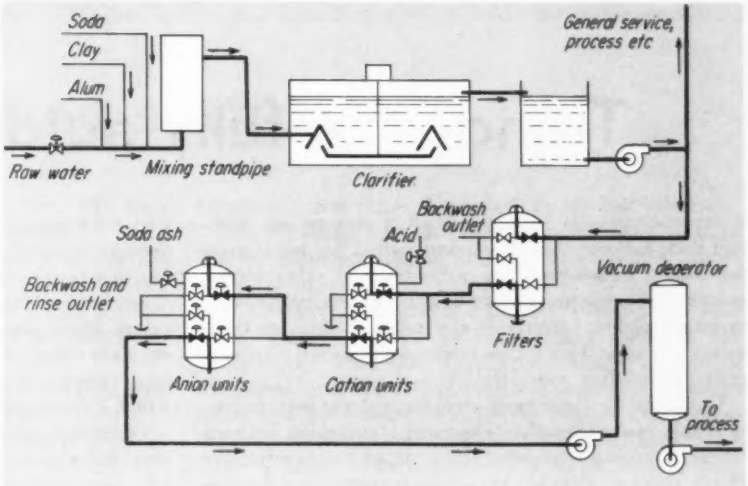
Negative electrode makes up one end of cell and positive electrode the other. Brackish water enters compartments between membranes. Positive sodium ions migrate to left toward the negative electrode. Negative chlorine ions go toward positive electrode at right. Sodium ions in center compartment pass through *MM* membrane to the left and are blocked by the next *NN* membrane. Chlorine ions pass through *NN* membrane to right and are blocked by the following *MM* membrane. This alternate passing and blocking removes ions from alternate compartments and concentrates them in neighboring sections. So salt-free water is drawn from one complete set of alternate compartments and concentrated brine from the other.

with end use

unit. When filled with activated carbon they remove taste and odor. Cartridge and leaf type filters, used for polishing, produce a sparkling-clear water by removing all fine solids.

Iron and manganese present as soluble, colorless divalent bicarbonates are removed by aeration, coagulation, settling, filtration. Cation units on sodium or hydrogen cycle also may do a good removal job. If present in colloidal or organic form coagulation, settling and filtration are needed. Iron can also be stabilized with chelating agents to prevent precipitation.

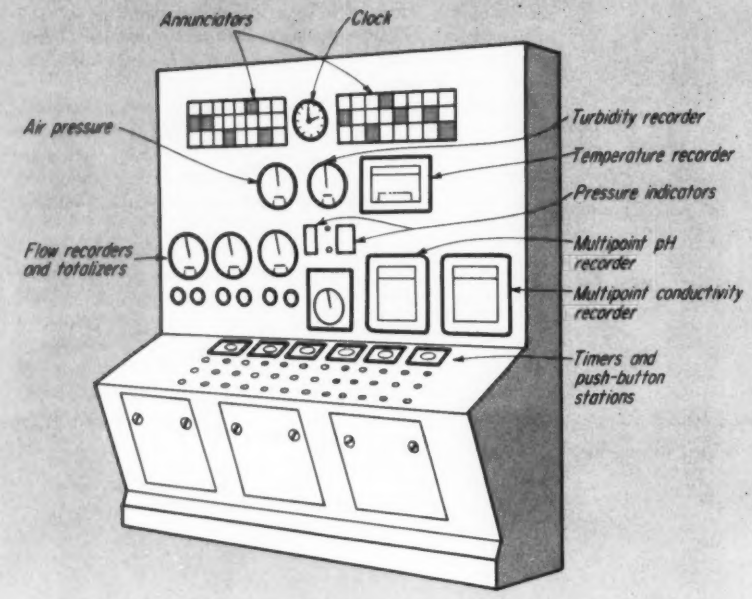
Mineral-free water is demanded by many processes. Both distilled and demineralized water are used. Demineralized water is uniformly high in quality and usually costs less. So its use is on the increase. Mineral-free water doesn't contaminate materials processed in it, nor does it leave mineral residues upon evaporation. Precipitates are not produced when mixed with water-miscible solvents. Mineral-free water doesn't break emulsions, coagulate colloids or deplasticize clay.



Treatment system meets dual plant needs

River-water supply for this steel mill is coagulated, softened and clarified. This water with less than 10 ppm turbidity is completely satisfactory for preplating treatment of steel and general plant services. But much higher quality is required for the production of tin plate that's free from streaks and other surface irregularities. Therefore part of clarified supply is sent through demineralizing units where conductivity is taken below 10 micromhos. A weakly basic anion exchanger is used since silica removal isn't required for this process.

Instruments and automatic controls are housed in dust-tight steel cubicle



Steel-cubicle method of installing instruments and electrical control has many advantages. First, resulting centralization of control greatly simplifies job of operators and maintenance men. Cubicles are usually completely enclosed and equipped with rear or front doors. This gives easy access for maintenance to electrical control equipment and wiring. Recorders, timers, control-panel switches, level indicators, annunciators and air-loading panels are installed on front of cubicle. Console type is shown although straight-vertical type can also be used. Complete unit is factory assembled, wired and tested. This means better workmanship at lower cost than is normally possible when controls are installed as individual field-erected units.

Trend is to fully automatic control

Automatic controls for water-treating systems are many and varied. Some control standardization has taken place for filters, cation-exchange softeners and other simple processes. But the usual water-treating system, particularly in larger plants, consists of a number of separate treatments in stages. This means repumping between stages or, perhaps, blending water from two of them.

Controls for these more complex systems require considerable instrumentation, electrical interlocking between stages, pumping equipment controls and comprehensive alarm systems. Possible variations in equipment hookup are so numerous that the control center, above, must be designed to suit each individual plant.

Operating valves used on automatic water-treating units include hydraulically operated gate valves, motor-operated multiport or single valves, diaphragm-operated globe and Saunders patent valves plus other special designs.

Multiport type valves are designed to replace the five or six valve nest arrangement on pressure filters and cation-exchange softeners. Since one valve does the work of many they are often called single valves. Standard automatic controls are generally available. Typical single valve will have a control box with motor, starter, timer and other control accessories mounted right at the unit.

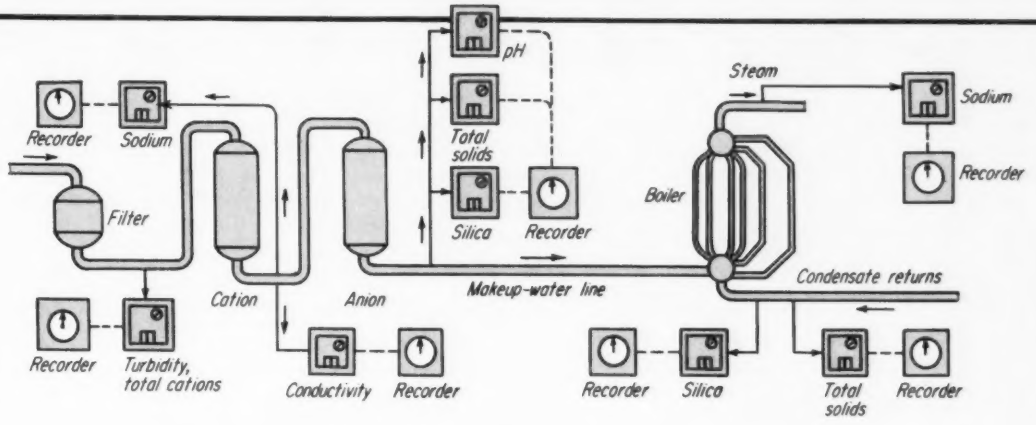
Pilot valves are used to control cylinder- and diaphragm-operated valves in water-treating equipment. They fall into four main classes: (1) solenoid valves (2) cam-operated pneumatic valves (3) cam-operated hydraulic valves and (4) disk-type hydraulic valves.

Solenoid valves generally control small diaphragm valves. Many plants also use solenoid pilot valves to operate main valves on complex mixed and multibed demineralizing systems. If many solenoids are used, mount them on a rack for easy maintenance.

Pneumatic pilot valves consist of a motor drive, camshaft and a series of 3-way pneumatic pilots. Each of these pilots can deliver air to, or exhaust air from the pilot line controlling a diaphragm-type main operating valve. These pilots are well-suited for control of ion exchangers using diaphragm-type valves. They are also used to control large cylinder-operated hydraulic valves. But this calls for a 4-way diaphragm-operated auxiliary valve for each hydraulic-valve cylinder on the ion-exchange or filter unit.

Cam-operated pilot valve uses water as the control medium. The valve, individually designed for each service, has a motor drive, camshaft and a number of valve units, each of which is essentially a 4-way valve.

Multiport pilot valves also control hydraulic valves. But cam-operated pilot type is usually preferred for the following reasons: (1) Proper cutting of the cam makes it possible to produce complex and special control cycles with relative ease. (2) Pilot valve itself can be installed in



Automatic chemical analyzers are key to complete automation

Conductivity and pH instruments automatically indicate and record. When an "off-normal" value occurs, they can be used to initiate corrective action. Typical applications include chemical feed and ion-exchanger control. Amount of acid fed into a cooling-tower-system may be controlled by pH of recirculating water. Rinse period during anion-exchanger regeneration is timer controlled, but with a conductivity override. However, it requires accurate monitoring of much more than these two variables before a fully automatic treating plant is possible.

Tomorrow's plant will use automatic chemical analyzers, above, at each stage of treatment and at critical spots in the feedwater or process cycle. Makeup turbidity, cations, sodium, silica and dissolved solids are tested continuously. Condensate is monitored for silica and dissolved solids. Finally, purity of steam is measured by analyzing for sodium. These instruments will sense "off-normal" values and automatically start corrective measures. Several are already available with expected accuracy within the range of 0.01 to 0.05 ppm.

# of water-treating systems

panels, control cubicles or operating tables. (3) Less maintenance is needed than for multiport type.

Auxiliary control devices are still needed to actuate the pilot valves. These may include (1) electrical relays (2) magnetic starters (3) timers (4) sequence switches (5) float switches (6) liquid-level controls (7) flowmeters and (8) conductivity and pH meters.

Instruments most commonly used measure flow, conductivity and pH. Flow instruments handle a variety of jobs ranging from control of chemical feeds to proportioning of flow. For example, flow of raw water to both cold- and hot-process softeners is measured. Volume of water passing through meter then controls rate at which lime, soda ash, coagulants, etc are fed to the softener.

Meters totalize the flow of water treated by individual ion exchangers. Exchange capacity in gallons between regenerations is calculated from incoming-water analysis. This capacity is set on the meter contractor. When preset number of gallons is registered by the meter an alarm sounds or the unit automatically goes into the regeneration cycle. Meter setting usually includes a safety factor.

Controlling flow rate is another important task. Split-stream dealkalizers pass one part of the incoming water through hydrogen-cation exchangers and the remainder through sodium-cation units. Flow split is calculated from raw-water analysis. Primary controllers keep flow in each circuit at preset values to produce the desired alkalinity.

Demineralizing systems employ many different types of controllers for acid, caustic and dilution-water flows. Backwash and rinse rates are also instrument controlled.

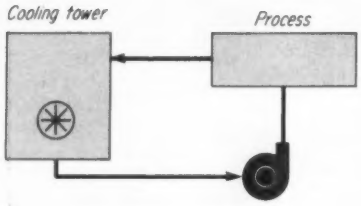
Conductivity instruments indirectly measure the total dissolved-solids content of concentrated solutions like boiler water. They also measure the quality of almost solids-free water from demineralizing systems. Strength of dilute acid and caustic flows during demineralizer regeneration is monitored continuously. Quality of anion rinse water is checked before exchanger is put back into service. The instrument can be a simple, locally mounted indicator or a multipoint recorder-controller mounted on the main control cubicle. Special conductivity systems are also used to signal end-point of ion-exchanger runs.

Chemical feed systems for the treatment of cooling water lean heavily on pH instruments for control. They are also helpful in monitoring plant waste-water discharge, particularly from demineralizers to prevent sending water with excessive alkalinity or acidity to the sewer.

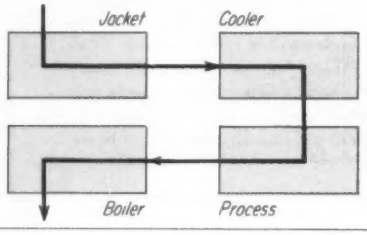
Alarm systems are an important part of every water treatment plant. Panel-mounted annunciators are ideal; they will indicate high and low level in storage and chemical solution tanks. Include alarm points for the end of service run on filters, ion exchangers, etc. Finally, provide alarms for high or low pH and conductivity measurements.

Smart design and operation cut water cost

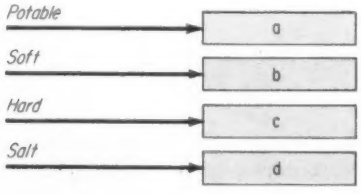
Better water management is called for when plant water demand runs ahead of supply or when plant water costs start to zoom. First step is a complete water survey. Assign the job to an engineer and give him staff help if needed. Another possibility is setting up a water committee that includes one of the plant engineers plus key men from big water-using departments. Consider use of outside water consultants for a fresh view of the problem. Below are five important ways that plant water management can be improved. Investigate these possibilities in your plant. Then prepare a detailed report listing specific steps that should be taken to reduce water consumption, lower overall cost.



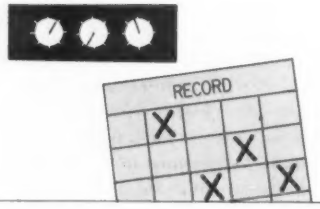
Look into advantages of evaporative cooling. In many plants greatest chance to save is by re-using water now discharged to waste from engine or compressor jackets, condensers, etc. This hot water can be cooled by evaporation if sent through a cooling tower, spray pond or evaporative condenser. With evaporative cooling the water loss is usually less than 5%.



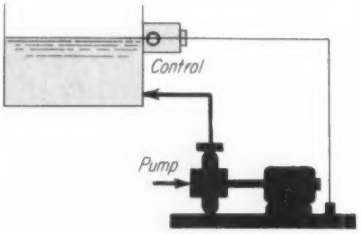
Investigate possibilities of multiple use. Water discharged from one use may be perfectly good for another. For example, cooling water may first go to processes needing a low temperature and then to others able to get along at higher temperature levels. Water heated in this fashion can then be used in some process needing warm water. Possibilities are endless.



Don't overlook savings of multiple supply. Water good for drinking may not be good enough for boilers. Sea water, good for neither, may be good for condensing and cooling. But some plants try to make the entire water supply good enough for deluxe uses. Duplication of pumps, piping, etc may be a small price to pay for a system that hoards the high-quality water.



Use meters and records to encourage saving. Meter the water delivered to each major department and find a way to estimate take of minor users. Follow through with a monthly report or make a direct charge against using department. This gives a real incentive to reduce consumption. Make sure your maintenance program insures regular inspection and repair of water system.



Install automatic controls where possible. They make sure water flows only where and when needed, without human errors. Typical examples are: float and pressure controls for tank makeup, thermostatic valves, etc.

The author gratefully acknowledges the help and cooperation of the entire water-treating industry in preparing both parts of this report. He especially thanks J F Wilkes, S B Applebaum, D Miller, S K Adkins, J M Seamon and D E Noll

Reprints available

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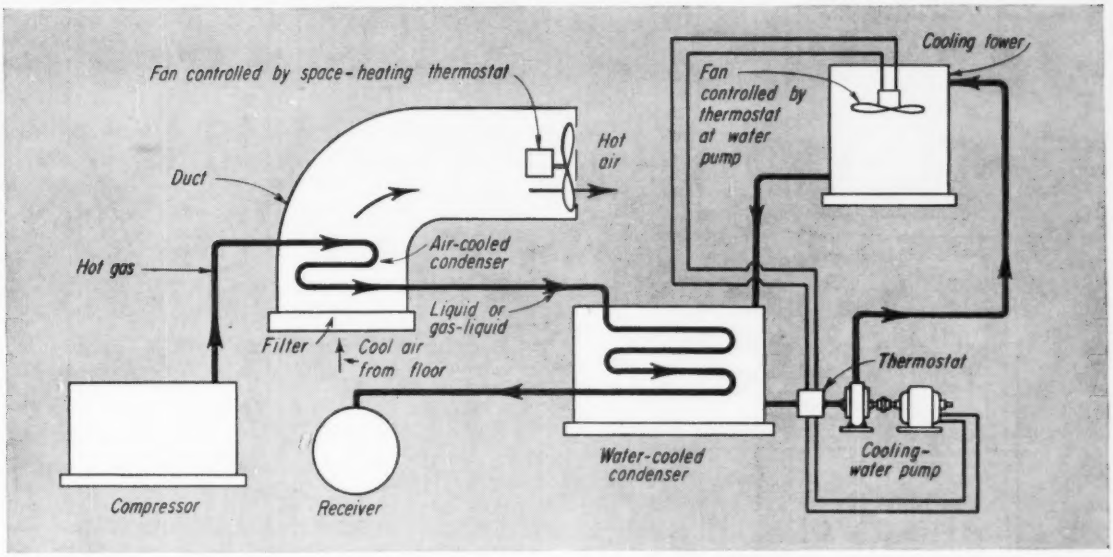


BOTH SIDES OF COMPRESSORS are put to work to end tug-of-war between refrigeration, heating systems. Air-cooled condenser recovers some 120,000 Btu per hr formerly rejected to cooling tower, sends hot air through ductwork, reduces load on space-heating units

Why waste heat?

By PAUL M STURGES, President, Sturges Heat Recovery Co, Inc

Why indeed? This question was uppermost in my mind as I surveyed the refrigeration system in a new supermarket in New Canaan, Conn.

Big problem was that space-heating calculations had been concluded before refrigerating equipment had been selected, and this overload omitted from the total. Thirteen compressors, 20-ton total capacity, conceivably could reject some 240,000 Btu per hr (plus heat of compression) to the cooling tower from which it would be lost forever. Assuming a winter minimum running time of 50% capacity, heat loss per hr would be roughly equivalent to Btu content of one gallon of No. 2 fuel oil fired with 70% boiler efficiency.

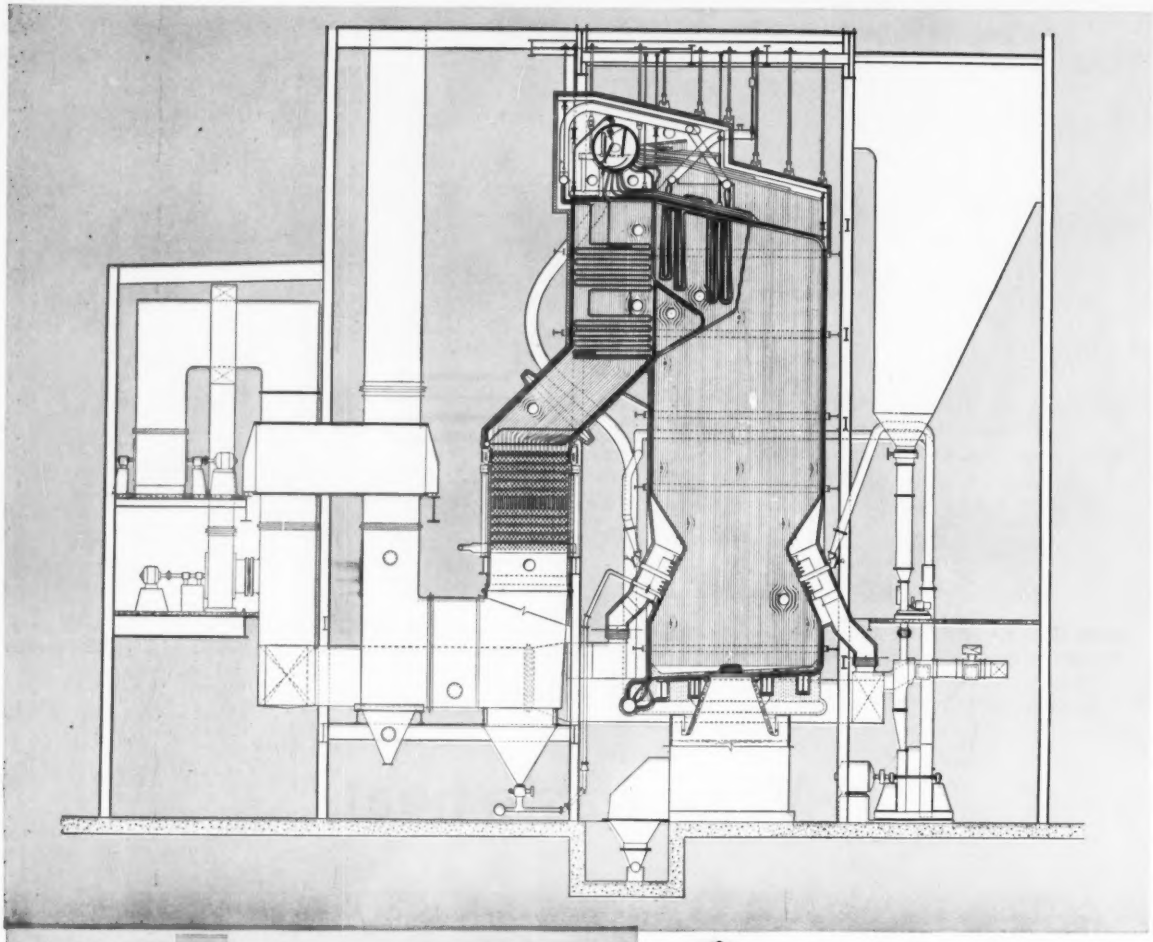
Not only was this heat being thrown away by the cooling tower, but it was costing more money to get rid of it. This was the electrical energy input to a 2-hp circulating pump and the tower's ¾-hp fan. At the same time, the hot-water heating system was trying desperately to keep the area comfortable. But refrigerated display cases, teamed with conduction and infiltration losses, were unquestionably winning this thermal tug-of-war.

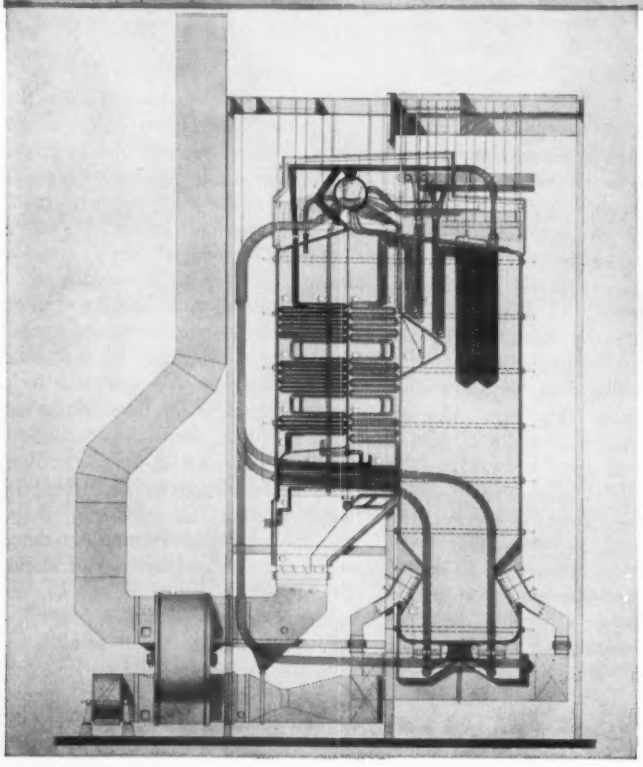
Solution was to put *both* sides of the refrigeration system to work. The heat was free, relatively speaking, so why not recover it? We constructed an air heater by mounting 12 air-cooled condensers and spotted it in a duct. In this duct we put a 1-hp 24-in. propeller type fan. The air heater, of course, doubles as a condenser located ahead of and in series with the refrigeration system's conventional water-cooled condenser. The fan pulls cool air from floor level, through filters, across the air-cooled condenser and discharges warm air back into the area at ceiling level. A thermostat controlling the fan is set higher than the heating system's thermostat. It turns on first when weather cools; turns off last when space heating is no longer needed.

Air-cooled condenser liquefies the refrigerant gas about 70% of the time. With all compressors running, the regular condenser is apt to come into play as it does when space heating isn't needed. Under the latter condition, hot gas merely cycles through the air-cooled condenser.

Additional benefit became evident when the new setup went into operation. Due to efficiency of new condenser, cooling-tower operation isn't required much of the time. When we discovered this, we added controls to automatically shut down circulating pump and cooling-tower fan when air heater handles full condenser duty.

On the basis of performance to date, we estimate annual savings of about 6500 gal of No. 2 fuel oil and 13,860 kwhr of electricity. Power used by the heat-exchanger fan is peanuts as compared to that used by the original heating system's oil-burner motor, circulating-pump motor and three fan motors housed in space-heating units.





A Progressive Chemical Company

One 400,000 lbs/hr Turbo Furnace Boiler: 830 F — 1250 psig. Unit is fired by pulverized coal from three Riley Pulverizers. A second Turbo Furnace Boiler of 600,000 lbs/hr has been purchased for a second plant at this location.

A Louisiana Public Utility

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- Uniform distribution of furnace gases across full width of the superheater with minimum variation in metal skin temperatures from side to side
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- Economical and quick conversion from gas and oil firing to coal
- Because of performance characteristics, the Riley Turbo Furnace can be operated at higher heat releases: The size of the unit is reduced thus reducing building costs and permitting higher capacity within a given space
- A wide furnace is possible without need for dividing walls
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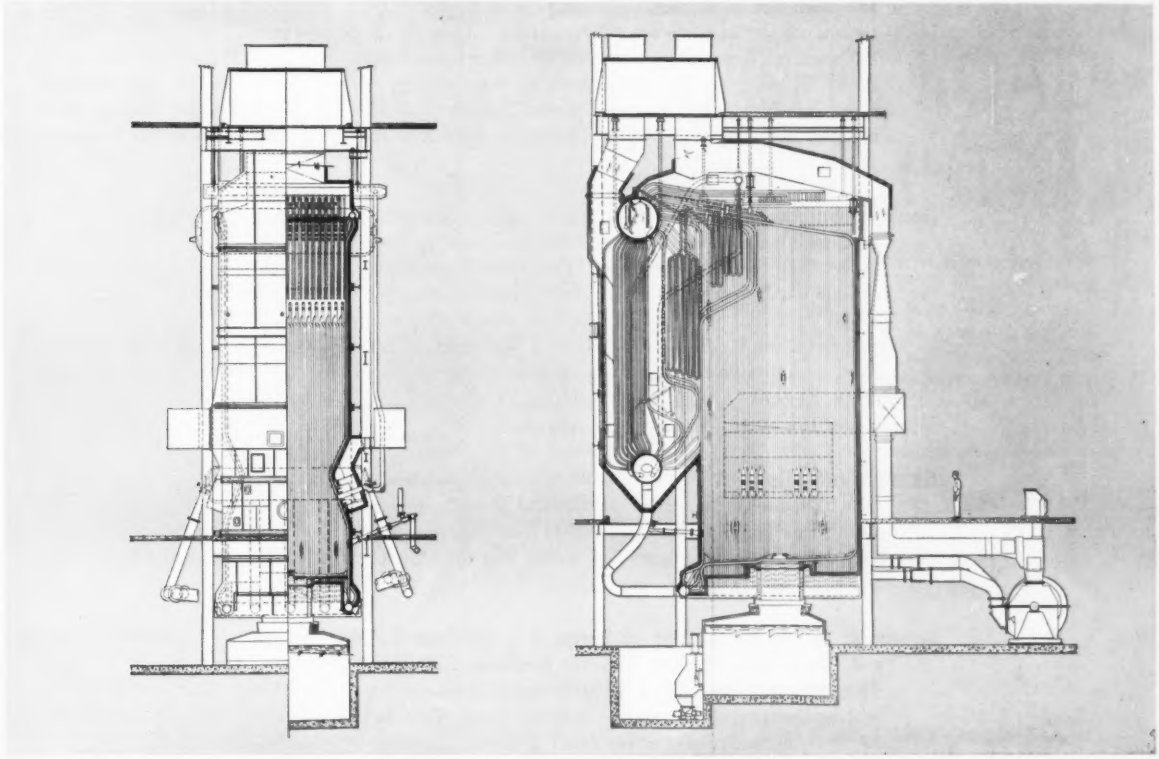
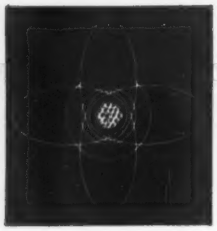


For more facts circle 244 on Reader Service Card, p 122



Nuclear notes

By B G A SKROTZKI, Associate Editor

Nuclear superheating will be used in Northern States Power Co boiling-water reactor (see POWER, Nov 1958, pp 94-95) according to AEC contract amendment filed with the Joint Committee on Atomic Energy. This change in the 66-mw unit to be built at Sioux Falls, S. D., leads Northern States to ask for $2.5 million additional research and development assistance and waiver of additional fuel-use charges of $800,000 for superheating during first five years. Revised total cost is $33.1 million towards which the AEC would contribute about $10.3 million. The forced-circulation Pathfinder reactor is scheduled to start June 1962.

Air-transportable skid-mounted pressurized-water reactor plant contract has been awarded to Alco Products, Inc, by Eastern Ocean District, Army Corps of Engineers (see POWER, Jan 1959, pp 61-63). The plant will produce about 1.5 mwe and about 1 million Btu per hr of heating steam. The $3.2 million plant will have a condenser cooling system using air and ethylene glycol with three skid-mounted air-blast coolers. The plant will be used for a remote frigid location and must be completed in the factory within 16 months. Plant will be in about 30 skid-mounted units, and need about 30 operators in the total crew.

Radioactively produced electricity with great weight and space economy was announced with much fanfare by AEC. A new device, SNAP III, 4¾-in. dia and 5½-in. high, weighing 5 lb produces 5 watts electric from radiations of 1/3 gram of radioactive material. The first "practical" unit uses polonium-210 to generate electricity with thermocouples at efficiency of about 10%. After the first 140-day half-life of the polonium the unit produces 3 watts at an efficiency under 6%. In two half-lives of 280 days, SNAP III can produce the same amount of energy as that from 1450 lb of conventional batteries. Martin Co and Minnesota Mining and Mfg Co developed the unit in four months at a cost of $15,000. They anticipate that the unit could be mass produced at greatly reduced cost.

Heavy-water moderated, pressure-tube type, slightly enriched uranium-fueled reactor will be built by Carolinas Virginia Nuclear Power Associates under the AEC's Power Demonstration Reactor Program. The reactor plant at Parr, S. C., (25 miles NW of Columbia) will produce 17 mwe in an adjoining conventional power plant. Capital cost to be paid by the Associates will be about $22 million; maximum cost to the AEC will be about $15.1 million. Stone & Webster will be architect-engineers; Westinghouse Electric will supply reactor equipment. Associates include: Duke Power Co, South Carolina Electric & Gas Co, Carolina Power & Light Co and Virginia Electric and Power Co.

Gamma radiations from radioactive gold produced electricity at an unannounced efficiency in a thermionic converter at General Electric's Vallecitos Laboratory in California. Using this principle and cerium-144 as source a power pack could generate more than 100 watts for over a year and weigh less than 25 lb. The hot side runs at 1700 F and the cold side at 800 F (see POWER, Feb 1959, p 59).

Survey of Initial Fuel Costs of Large U.S. Nuclear Power Stations, December 1958, published by the Edison Electric Institute, 750 Third Ave, New York 17, N. Y., predicts that fuel costs for four large nuclear plants coming into service in early 1960's will be less than half of Shippingport costs. This 34-pp pamphlet costs $1 to members, $2.50 to nonmembers, order from Institute directly.

THE YARWAY FAMILY OF FINE STEAM TRAPS

SERIES 60—normal needs, pressures to 400 psi, 6 sizes. **SERIES 120**—normal needs, pressures to 600 psi, 6 sizes. **SERIES 40**—for extra heavy loads, 5 sizes. **NO. 30**—for extra light loads (½" only). **INTEGRAL STRAINER**—highest pressures and marine use, 6 sizes.

NEW NO. 30 IS A LIGHT LOAD SPECIALIST

When the condensate load in your steam lines is *extra light*—this new Yarway ½" No. 30 Steam Trap is *exactly right.*

Specify it. You'll experience new *economy of operation* with the *tighter shut-off.* Operation is *quieter* due to lever action. *Maintenance is less*—because of the replaceable valve-seat assembly, only one moving part and stainless steel construction. Enjoy these special features plus all the regular advantages of famous Yarway Impulse Traps such as *quick heating, even temperatures, small size, good for all pressures, non-freezing.*

Over 1,250,000 Yarway Impulse Traps already sold; buy yours from one of 270 local Industrial Distributors.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

YARWAY *impulse® steam traps*

For more facts circle 245 on Reader Service Card, p 122

Reserved for your comment

BOB BELLAS, Associate Editor

Report echoes

Congratulations to Bob Marks for an excellent report. (*Water Treatment,* Part I, December 1958, pp 73-104.) It's a real tribute to POWER.

This paper is a comprehensive, well organized and attractively illustrated coverage of the various aspects which must be considerd in preparing water for industrial use. Yet it's characterized by good readability and commendable brevity without understating the importance of the problems encountered. Sections devoted to basic water chemistry and chemical treatment are highly informative and will undoubtedly find wide usage in industrial training programs. The complete objectivity noted in the discussion of today's water-processing equipment should render this information quite valuable for making equipment selections. Some discussion of condensate treatment would be desirable. It's of major interest in power station operation because iron and copper pickup in the condensate cycle adversely affect high-pressure boiler performance. Too, some coverage of evaporators vs demineralizers for makeup production would be welcome as would mention of water treatment in the nuclear field. I may be jumping the gun somewhat, since it may be Marks' intent to touch these bases in the forthcoming Part II of this paper.

DR S F WHIRL
Chemical Operating Engineer
Duquesne Light Company

EDITOR'S NOTE: *With this issue comes Part II of Bob Marks' report. We're confident that "Doc" Whirl, in addition to many other readers who suggested additional coverage, will agree that the complete report does a comprehensive job despite its 56-page limitation. However, since every man is entitled to his opinion and a right to express it, we're voicing a final call to those who'd like to get aboard with their comment.*

. . . You have made a complex subject readable and understandable through good organization and an attractive format.

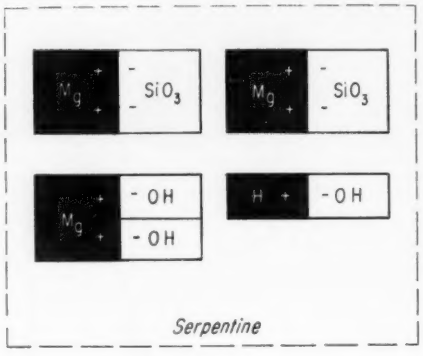
The brief discussion of "what water quality does your plant *really* need?", p 74, is particularly important to engineers concerned with design of new plants or additions to existing ones. Adopting the concept of the *most suitable water for the job* rather than *the best water* can save thousands of dollars in equipment and operating costs.

Congratulations on another valuable POWER report. We're looking forward to Part II.

J M SEAMON, *Product Manager*
National Aluminate Corporation

. . . It's an excellent review of water-treatment chemistry and provides a fine description of the various pieces of equipment that may be used for removing impurities from water.

The building-block method is particularly useful in showing how cations and anions combine to form compounds. This method probably provides the clearest explanation of water chemistry that we've seen for those who've had little or no high-school chemistry. However, use of building blocks is a little too pat to show in a simple manner how some important compounds form. For example, in lime-soda softeners, magnesium is frequently precipitated as serpentine rather than magnesium hydroxide when silica is present. This compound would have to be shown by four complete blocks, each showing a balance between positive and negative ions:

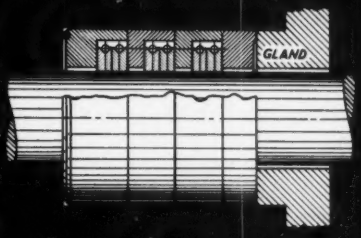


Referring to the table on p 83 showing *P* and *M* alkalinities, it's a common fallacy that the relationships indicated for hydroxide (OH), carbonate (CO_3) and bicarbonate (HCO_3) represent ions in solution. This is not true. They actually represent amounts of dry chemicals used to prepare the solution. To illustrate, a solution prepared from pure sodium carbonate ($NaCO_3$) will exhibit a *P* value equal to half of the *M* value, but the solution will actually contain ions of Na^+, OH^-, $CO_3^{=}$ and HCO_3^- owing to reaction with water. When it's necessary to show amounts of individual ions present, as when calculating acid requirements for adjustment of pH, dissociation constants for carbonic acid (HCO_3) must be employed.

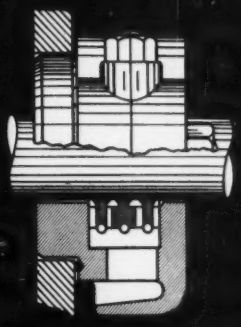
D E NOLL, *Staff Engineer*
Hall Laboratories
Div of Hagan Chemicals & Controls, Inc

. . . A magnificent coverage in only 32 pages of subjects concerning water. Very effective use is made of illustrations which, without such handling, would require much detailed discussion. All subjects are presented so as to be useful as basic mate-

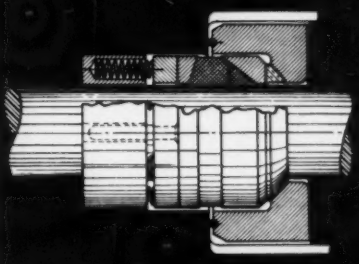
For more facts circle 246 on Reader Service Card, p 122



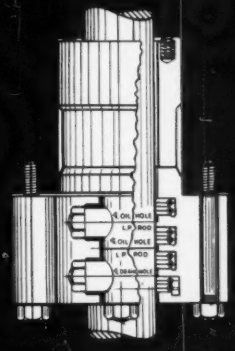
STYLE 308: Solid inside cup. Cannot distort. New rings can be installed with rod in place.



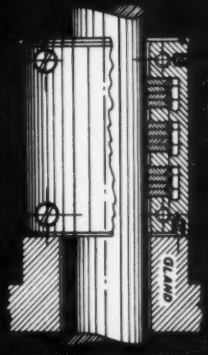
STYLE 128: Bulkhead or splash plate type with bronze rings. Designed to meet any oil condition.



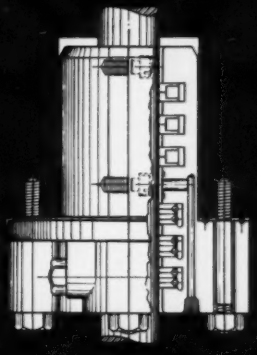
STYLE 141: Solid case type for coreless valve stems. Case can be pushed back.



STYLE 414: Sturdy marine type for medium and low pressure rods and valve stems.



STYLE 316: Widely used type of inside split case.



STYLE 617: Split type, with oil tap, for high pressure and high speeds.

The 6 Machined Metal Packings Specified by Most Engineers

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Find It Fast in the "Yellow Pages"

Yet these are just a few of the many Anchor Machined Metal Packings being supplied. You can be sure—whatever the application—that Anchor can furnish just about any stock or special metal packing that you may need.

Anchor Machined Metal Packings are made for use with ammonia, steam, CO^2 and other gases and liquids. Highly refined carbon rings for use on non-lubricated rods and with gases that are corrosive to other packing materials are also available.

For further information on machined metal packings or other Anchor products, see your local Anchor Representative. Or, contact the Anchor General Office in Philadelphia. Ask for your copy of the Anchor catalog.

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● *FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE*

rial for those not familiar with water treatment as well as a review for those who are. Many new and important developments are covered.

Marks deserves congratulations for his valuable contribution to the water-treating industry. Undoubtedly all who have read Part I are looking forward to publication of Part II.

J S BEECHER, *Chief Chemist*
E F Drew & Co, Inc, Power Chemicals Div

. . . I was immediately caught up by the opening paragraphs dealing with the availability of water and water consumption. According to the report, industry uses 111 billion gallons daily, of which 98% is re-usable. Therefore, net consumption is 2 billion gallons every 24 hours.

Municipal and rural supplies systems consume 19 billion gallons, of which 90% is re-usable. Here, net consumption is 1.9 billion gallons.

Irrigation takes 110 billion gallons per day and, since most of that becomes ground water, at least 90% of it is re-usable. Thus net consumption is 11 billion gallons. So, combined net consumption is only 15 billion gallons per day. Where do you get the 87 billion figure?

"Report of water analysis," pp 80-81, in the report looks impressive and is undoubtedly quite understandable to the average water chemist. But, to an engineer it's "greek." Can he look at it and tell whether the water is corrosive or scale forming? I doubt it. Why didn't you include the method of determining the Langelier Index which would enable an engineer to figure on scale-forming or corrosion potential of a water from its analyses, at any temperature? This would have brought home the fact that a single water supply may be corrosive in a cool section of a system and scale forming in the hot section of a system.

T T PECK, *Chief Chemist*
Polyphase Chemical Service, Inc

EDITOR'S NOTE: *Nothing wrong with Reader Peck's arithmetic, we'll admit. But we suggest that he take a harder look at the report's opening paragraphs. We didn't pull the word "available" out of our sleeve. It was there (in the text) all the time. There's a difference between "98% is available for re-use" and "98% is re-usable." If one assumes, as Reader Peck apparently did, that we* ARE *re-using all water* AVAILABLE *for re-use, then his net consumption figures would be correct. But this isn't the case, unfortunately. We're wasting much water* AVAILABLE *for re-use, though we're improving as time goes by. As the report points out, re-use made possible through smarter water-treatment methods has lowered total daily* CONSUMPTION *from a resounding 240 to 87 billion gallons per day.*

Referring to Langelier Index, see section dealing with cooling water in report's Part II, this issue.

. . . A much needed compilation of the basic elements of this subject. It's only regretful that so much had to be condensed into the allotted space. I hope that each of these phases will be further explored and rendered as easily digestible.

This report will give the plant engineer a greater understanding of his water problems and, as a result, he'll be better equipped to cooperate with water-treatment engineers in obtaining and maintaining the desired results for his particular operation.

PAUL BRINDISI, *Consulting Chemical Engineer*
Celco Laboratories

Materially speaking

I liked the heat-transfer article ("High heat transfer for stainless," February, p 75). I was impressed by the disclosure and the straight-from-the-shoulder presentation of data. However, your reference to "iron deposits" left me hanging. Is this a foreign iron being deposited in the tubes, or a corrosion product of the stainless tubes?

I'm wondering about longevity of the stainless-steel tubes and cost of stainless steel vs brass. Perhaps it's too early to form sound conclusions?

Type-329 stainless has an interesting background. It puts up a great fight against stress-corrosion cracking, which is the scourge of heat exchangers and condenser units. May we look forward to more information on such applications? I'm sure a follow-up article would appeal to power-plant engineers responsible for the selection of metals.

G E LINNERT
Supervising Research Welding Metallurgist
Armco Steel Corporation

EDITOR'S NOTE: *The article was amiss in not pointing out that the iron was being deposited by river water; not coming from any part of system.*

Reader Linnert is correct in assuming that longevity and comparative cost evaluation will have to await the outcome of still-continuing tests. POWER *will deal further with the subject.*

Since we're concerned with stainless steels at the moment, this seems like a good time to focus attention on a new book titled: "Welding Type-347 stainless-steel piping and tubing" authored by G E Linnert. Long considered an "old faithful" in the stainless-steel group. Type-347 began showing tempermental tendencies. So much so that some question its continued use in new and important uses.

In his 103-p book (Price $3.50), Linnert literally and figuratively turns Type 347 inside out for the reader. Using much previously unpublished data, this book is a real contribution to solution of problems posed by Type 347's behavior. You can get copies from the American Welding Society, 33 West 39th Street, New York 18, N. Y.

(Advertisement)

Maintenance and Steam Traps

. . . there's a relationship that goes far beyond trap maintenance alone

Good traps and good trapping have a greater effect on your maintenance costs than does trap maintenance itself. By that we mean that the right traps, properly selected and installed, and with the benefits of a preventive maintenance program, will save far more maintenance dollars than they will cost.

Under the pressure of spiralling maintenance costs, this thought becomes mighty important. Let's take a look at what it involves:

Proper Selection of Steam Traps

1. Be sure it's the right type of trap.

2. Be sure it's sized right and is for the correct operating pressure.

3. Be sure it's first rate in design and construction.

Proper Installation of Steam Traps

1. Install them so they are accessible for inspection and maintenance.

2. Install a test valve.

3. Use a union or unions.

4. Use a shutoff valve or valves.

5. Use a strainer ahead of the trap if dirt conditions are bad.

6. Use a by-pass only where continuity of service is imperative.

7. Standardize inlet and outlet connections.

Preventive Maintenance Program

1. Test trap regularly for proper operation. (Trap size, operating pressure and importance determine frequency.)

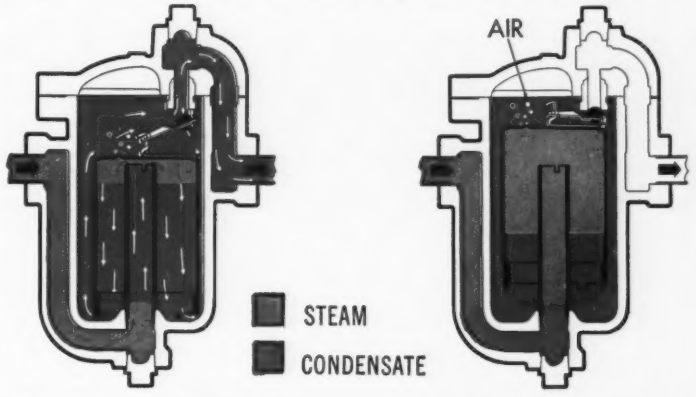
2. Inspect internal mechanism at least once a year.

You Get Indirect Benefits As Well

The direct benefits of the plan outlined are pretty obvious — good traps, properly selected, require less maintenance . . . testing and inspection prevents troubles that lead to maintenance.

However, this plan provides indirect benefits which reduce maintenance in other parts of the plant as well:

HERE'S THE STEAM TRAP DESIGN THAT CAN REDUCE YOUR MAINTENANCE PROBLEMS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

and burning equipment and on ash handling equipment.

Good traps protect the system by eliminating water hammer and preventing the damage it can do.

Good traps discharge carbon dioxide before it can go into solution to form corrosive carbonic acid —less corrosion, less maintenance.

Good traps increase production to reduce the length of time equipment must operate or reduce the amount of equipment needed . . . either way maintenance is reduced.

How to Go About It (The Sales Pitch)

We admit we're prejudiced, but we don't think there is any better way to select steam traps than with the help of the 44 page Armstrong Steam Trap Book. Here in a single source is specific data on the selection and sizing of traps, how to install them for best results, and how to maintain them most economically.

The Steam Trap Book will also give you full information on the design and construction of Armstrong Inverted Bucket Steam Traps that offer these important maintenance-reducing advantages:

1. Armstrong Traps are dependable.

2. Armstrong Traps require no adjustments — go from full load to zero load automatically.

3. Armstrong Traps are self-scrubbing—ordinary dirt conditions can't hurt them.

4. Armstrong Traps have long-life parts — valve and seat are heat treated chrome steel — lever assembly and bucket are stainless steel.

5. Armstrong Traps have water sealed valves to minimize wire drawing and erosion.

Ask for your copy of the Steam Trap Book—there is no obligation. Then test Armstrong Trapping. If you are not completely satisfied with the results, you can return the traps for a full refund of the purchase price. You can't lose much that way. Call your local Armstrong Representative or Distributor, or write

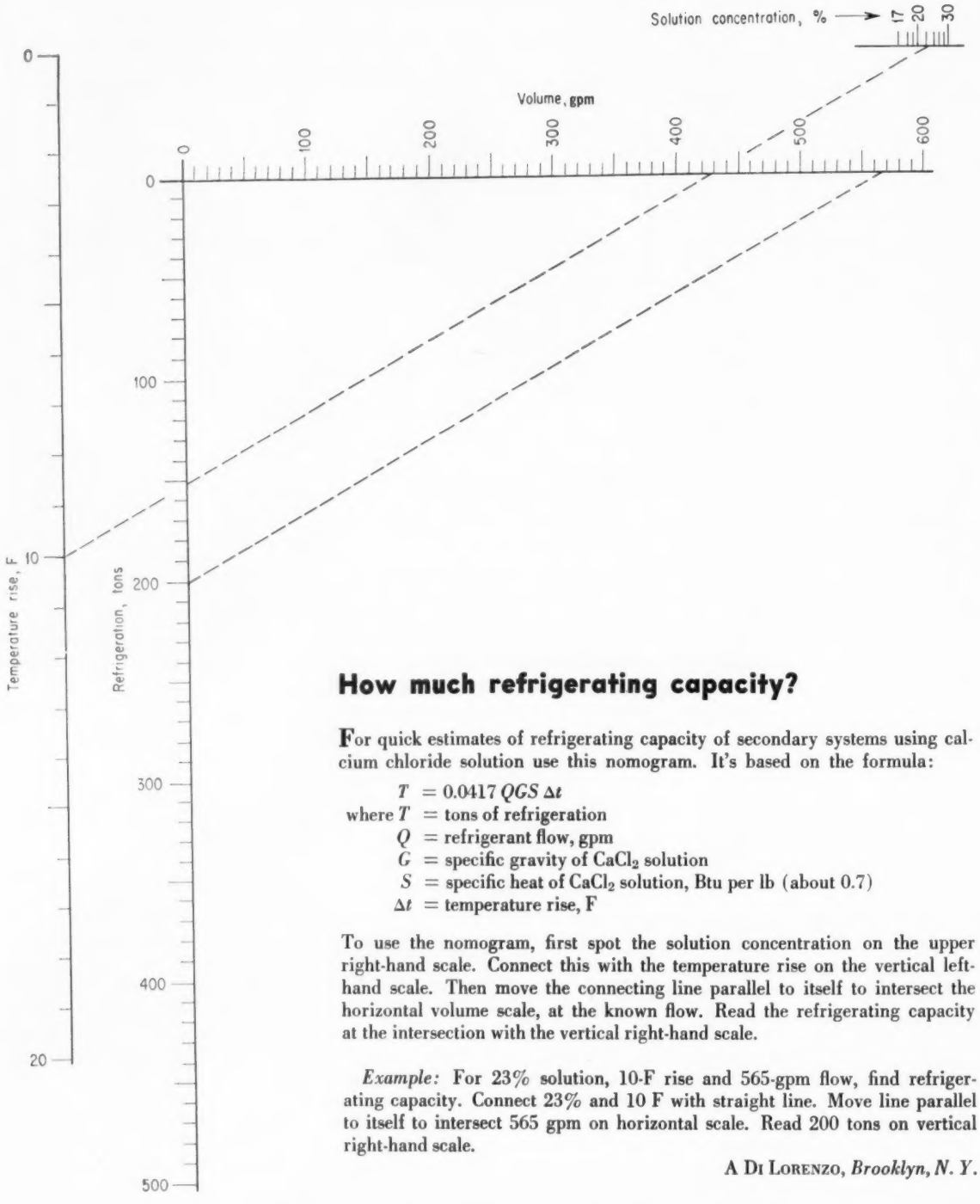
Armstrong Machine Works
8126 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

For more facts circle 247 on Reader Service Card, p 122

Power's data sheet

No. 319



How much refrigerating capacity?

For quick estimates of refrigerating capacity of secondary systems using calcium chloride solution use this nomogram. It's based on the formula:

$$T = 0.0417\,QGS\,\Delta t$$

where T = tons of refrigeration
Q = refrigerant flow, gpm
G = specific gravity of $CaCl_2$ solution
S = specific heat of $CaCl_2$ solution, Btu per lb (about 0.7)
Δt = temperature rise, F

To use the nomogram, first spot the solution concentration on the upper right-hand scale. Connect this with the temperature rise on the vertical left-hand scale. Then move the connecting line parallel to itself to intersect the horizontal volume scale, at the known flow. Read the refrigerating capacity at the intersection with the vertical right-hand scale.

Example: For 23% solution, 10-F rise and 565-gpm flow, find refrigerating capacity. Connect 23% and 10 F with straight line. Move line parallel to itself to intersect 565 gpm on horizontal scale. Read 200 tons on vertical right-hand scale.

A Di Lorenzo, *Brooklyn, N. Y.*

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News and Notes on...

Good Packing Practice

JOHNS-MANVILLE JM PRODUCTS

Maintenance and Design Hints from Johns-Manville Packings and Textiles Dept.

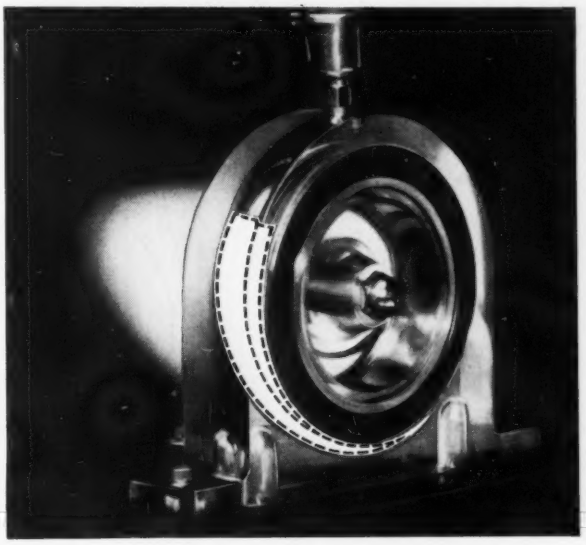
Subject of the month: Effective Shaft Sealing

Question: What is an economical way to seal in or seal out with maximum efficiency?

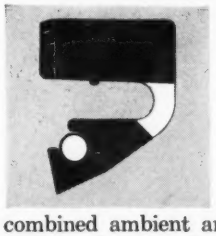
Whether the shaft bearing is of the sleeve, roller, or ball type . . . seals should meet two basic requirements: (1) provide a tight seal despite light applied pressure, and (2) resist abrasion and corrosion.

The transparent unit shown at the right was created by research engineers to study this subject of effective sealing . . . witness the performance of J-M seals in development stages. It helped them perfect the versatile, dependable line of J-M Clipper® Seals that serve many industries.

In this unit, Clipper Seals are mounted on a transparent cylinder, just as in a bearing cavity. The heel of the seal provides the rigidity essential for a press fit. The lip is flexible and soft so as to snug the shaft with a minimum of friction. Thus it acts like a gasket and effectively stops leakage.



HERE ARE JOB-TESTED RECOMMENDATIONS FOR COMMON SEALING APPLICATIONS:



For General Service—Type LPD All Purpose. This line-contact Clipper Seal provides long life and maximum sealing effectiveness under a wide range of equipment variables. Its synthetic rubber base compound is recommended by J-M for most sealing lip applications where combined ambient and operating temperatures reach 250°F and higher. It seals practically all fluids . . . has proved highly effective against oils and greases, hot and cold water, air and many other gases and vapors. And it maintains its high efficiency despite time, high temperatures, and adverse conditions.

For Small Clearances—Split Clipper Seals. Split Clipper Seals have wide acceptance as temporary replacement seals for equipment with space or design limitations . . . to save costly downtime. Installation in inaccessible space is relatively simple and speedy. They are practically fracture-proof . . . stand up under the rough treatment . . . can be forced into position around the shaft. They give long-term, efficient sealing until a major overhaul permits replacement with solid seals.

For further data on Clipper Seals write for Book PK-71A. Address: Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

For Continuous High Speed Operations—Type LPD Metal-Reinforced. This Clipper Seal, incorporating a metal reinforcement, is ideal for use in continuous high speed and extremely abusive service such as encountered in the steel industry. It expands and contracts with the chuck in which it is installed. It is a combination of two synthetic rubber base materials that are highly resistant to cracking, hardening and shrinking.

For Small Shaft Diameters—Type SS Springless. Here's the Clipper Seal designed for smaller cavities. It is made of a selected synthetic rubber base compounded to minimize swell and deterioration in corrosive applications where chlorinated solvents, lubricating oils carrying severe additives, or similar aggressive fluids must be sealed. It is a complete part in itself—contains no metal spring. No spring is required because this seal is designed to exert sufficient lip interference on the shaft to compensate for wear over a long period of time.

JOHNS-MANVILLE

For more facts circle 248 on Reader Service Card, p 122

How to get a "custom" pump at a standard price

Here's a new line of vertical centrifugal pumps easily tailored to your exact needs.

For process transfer or heavy-duty sump service, these pumps have features which assure long trouble free life with a minimum of maintenance.

Because they're built from standard parts, delivery is fast and there is no premium charge for custom building. When you want to change pit depth or pump ratings, you merely replace necessary parts. Units may be adapted in the field. Shafts and pipe columns are available for any pump length from 2 to 20 ft. in 6-inch increments.

There are types for wet or dry pits, with capacities to 1080 GPM or heads to 290 ft. Vaporproof construction is available.

Complete details in Bulletin 726.2.

GOULD PUMPS, Inc., Dept. PO-3, Seneca Falls, N.Y.

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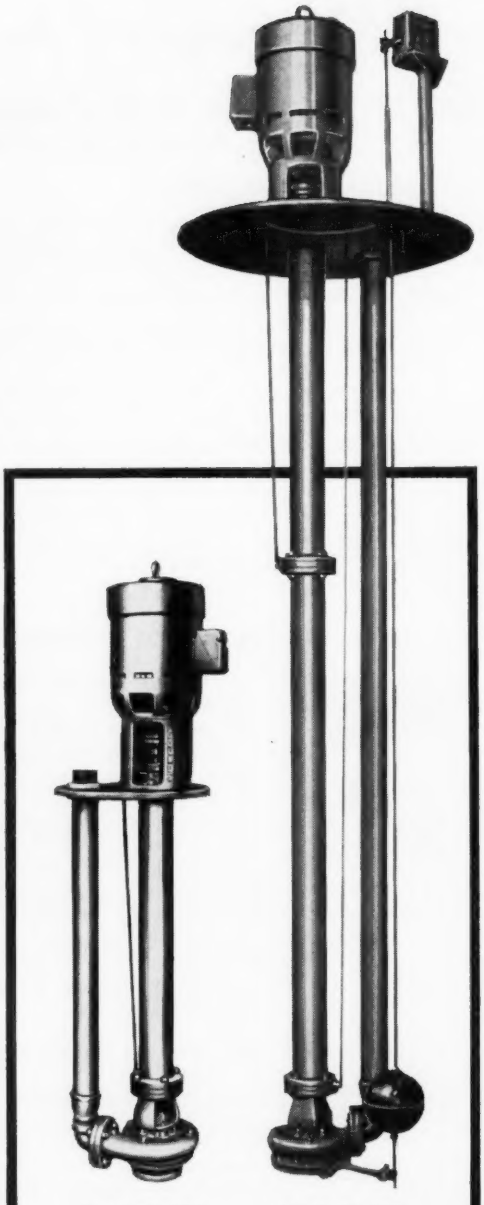

Goulds Fig. 3173 Goulds Fig. 3171

GOULDS

PUMPS FOR INDUSTRY

boilers, sometimes, need a change of diet, too

The proper "diet" is as important to your power and cooling system as it is to you. Almost any average diet will keep you alive. But it may take a skilled diagnosis of your particular dietary needs to show you how to keep yourself in really top shape.

So, too, with your power and cooling systems. You're feeding them a water treatment "diet" now and they're operating. But for peak performance and minimum down-time, they may need a change.

It's only good business to have a check-up before real trouble starts. Whatever your water problem—analysis, testing or treatment procedures for boiler water, condensate, cooling towers, process waters—Dearborn has the engineers and the chemists, the laboratory facilities and the experience to make accurate diagnoses for you. If all's well, their findings will be reassuring. If not, their prescription and consulting service program will help you avoid problems... give you the program exactly suited to your needs. Write for details of Dearborn's consulting service program.

DEARBORN CHEMICAL COMPANY

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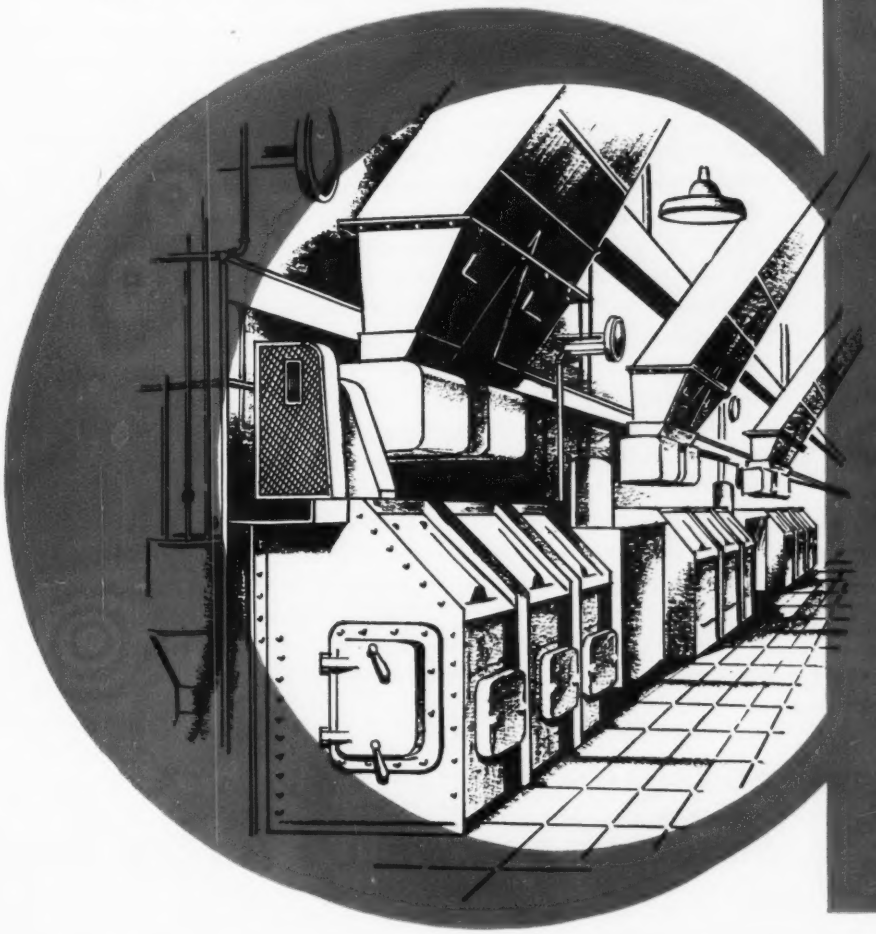


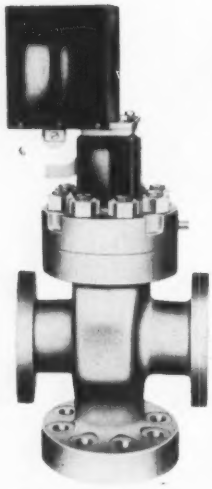
pioneer in the science of corrosion control

dearborn

For more facts circle 250 on Reader Service Card, p 122

PRESSURE LOADED SEATING

minimizes leakage and maintenance



Consolidated Electromatic Relief Valve. Sizes: 2½" to 14". Pressures to 3000 psi. Temperatures to 1120°F. Double Outlet.

Consolidated Electromatic® Relief Valves save steam, pure water, fuel, and "wear and tear" on your spring-loaded valves. Pressure loaded seating permits closer adjustment between operating pressure and set point than in spring-loaded valves. Many Electromatics are used to purge superheaters for faster startups and as superheater vent valves. They greatly reduce chances of superheater damage when firing up a cold steam generator or banked boiler.

Pressure loaded seating is created by channeling steam from the pressure vessel around the Electromatic's exhaust and into its main and pilot valve chambers. Steam pressure in both chambers always matches that in the vessel when the Electromatic is closed.

When pressure exceeds the Electromatic's set point, a signal from controller to panelboard control station results in solenoid thrust that opens the pilot valve, venting the steam faster than it can enter the pilot valve chamber through the clearance between the main valve disc and guide. With pressure in the chambers unbalanced, the main valve opens; steam exhausts until boiler pressure is reduced to the pre-determined setting of the controller. The pilot valve and the main valve close instantly at this point. Action is so fast, the closely adjusted Consolidated Electromatic normally relieves overpressure before the spring-loaded valve's set point is reached. For automatic or manual operation or to cut the valve out of service, a switch is provided on the control station. Send for Bulletin 720.

MAXWELL MANNING & MOORE INC. MM TRADE MARK

CONSOLIDATED SAFETY VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more facts circle 251 on Reader Service Card, p 122

Underground hot pipes insulated with GILSULATE® keep heating costs low

About 25 tons of Type B GILSULATE *were used for insulating and protecting the underground hot piping system at Hilltop School.*

A. M. Kinney & Associates, Cincinnati . . . Architects & Engineers
A. M. Kinney, Engineer; Charles Burchard, Architect

In designing the Hilltop Elementary School in Wyoming, Ohio, the architects took advantage of a low-cost, sloping, wooded area by planning a four-building campus-type school. Costs for site preparation were 8% less than for a conventional single-building school of similar quality.

The Hilltop Elementary School in Wyoming, Ohio, is an example of how the use of modern design and materials can cut construction costs and still result in an attractive, efficient plant.

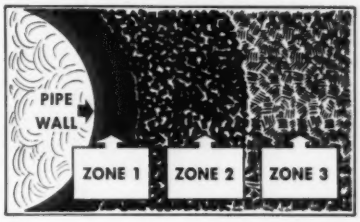
The school has four buildings housing 13 classrooms, multi-purpose room and dining facilities. It is heated by a high temperature hot water system operated by a gas-fired water tube boiler. 400 feet of underground hot pipes, insulated with GILSULATE and running underneath the covered walkways connecting the four buildings, carry the heat to radiant panels installed flush with ceilings.

GILSULATE is ideal for the protection of underground hot pipes. In addition to its low thermal conductivity, it resists attack by acids, alkalies and electrical conductivity, is impervious to mold and plant growth, and is waterproof as well. Investigate the value of this easily-installed, low-cost insulation. Use the coupon below for complete information, or contact your nearest GILSULATE distributor.

FACTS ABOUT GILSULATE

1. **EASY TO USE**—just pour and tamp...pipe heat does the rest.
2. **FORMS 3 ZONES** of protection against heat loss and all hazards commonly encountered by buried hot pipes.
3. **NEEDS NO HOUSING OR MECHANICAL SHEATHS**: no mixing, special handling or equipment.
4. **ONLY NEEDS NORMAL PIPE SPACING**: for multiple pipe or cramped conditions.
5. **THREE TYPES AVAILABLE:**
   Type A for 220°—300° F. temp. range
   Type B for 300°—385° F. temp. range
   Type C for 385°—520° F. temp. range

Triple-Zone Structure



ZONE 1—a dense semi-plastic core of GILSULATE fused on by the pipe's own heat.

ZONE 2—a sintered zone of GILSULATE particles. An excellent insulator, moisture-proof.

ZONE 3—GILSULATE granules provide a final zone of thermal insulation.

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF UNDERGROUND HOT PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY, SALT LAKE CITY 1, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California
Distributors in principal countries of the world

Do you receive Pipe Insulation News? Ask to be put on our mailing list.

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Salt Lake City, Utah

Send me more information on GILSULATE Insulation.

NAME .....
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COMPANY .....
ADDRESS .....

For more facts circle 252 on Reader Service Card, p 122

The big advantages of Taper-Lock mounting are now available for practically all of your sprocket installations. Below is listed the new wide range of types and sizes offered by Dodge!

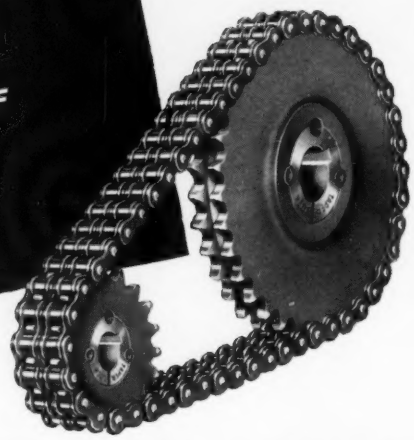
This important expansion of the Dodge line is the result of the enormous popularity of the Taper-Lock idea. Taper-Lock Sprockets are *modern*. Industry likes them because they go straight from shelf to shaft without machining—saving time. They are "easy on—easy off"—saving work. Their bushings can be re-used, not only in replacement sprockets, but in sprockets of different sizes and also in Taper-Lock Sheaves, Couplings, Conveyor Pulleys. Taper-Lock saves inventory—and money!

Dodge Taper-Lock Sprockets and Dodge Roller Chain are available through your local Dodge Distributor. Call him. Or write us for bulletin.

TAPER-LOCK®

ROLLER CHAIN DRIVES ARE NOW AVAILABLE IN A NEW WIDE RANGE OF TYPES AND SIZES

No Reboring!
No Keyseating!
No Waiting!



DOUBLE PITCH CHAIN and SPROCKETS

Transmission Series (No. 2040 to 2080) and Conveyor Series (No. 2040 to 2100). Sprockets to 112 teeth—including, for the first time, stock sprockets of 17, 19, 21, 23, 25 and 35 teeth *made especially for double pitch chain*. Introduced by Dodge, these sprockets are designed for even distribution of tooth engagement and absolute accuracy of mesh. Wear is reduced by half. Life of chain and sprocket is doubled!

PLATE SPROCKETS

Steel Plate, Type A. No. 35 to 120. Mandrel bore, bored-to-size or Taper-Lock.

SINGLE STRAND CHAIN and SPROCKETS

No. 35 to 160. Sprockets to 112 teeth.

DOUBLE STRAND CHAIN and SPROCKETS

No. 35-2 to 80-2. Sprockets to 112 teeth.

STANDARD ATTACHMENTS

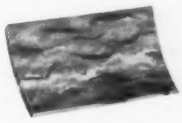
ALL TO ASA STANDARDS

DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER — your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

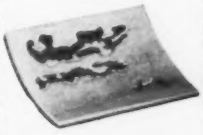
DODGE MANUFACTURING CORPORATION, 3200 Union Street, Mishawaka, Indiana

With no lining at all



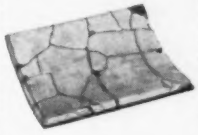
Unlined steel heaters are subject to corrosion even under normal service.

With plastic lining



There is no known plastic or phenolic lining that will withstand temperatures required for hot water service.

With ordinary concrete lining



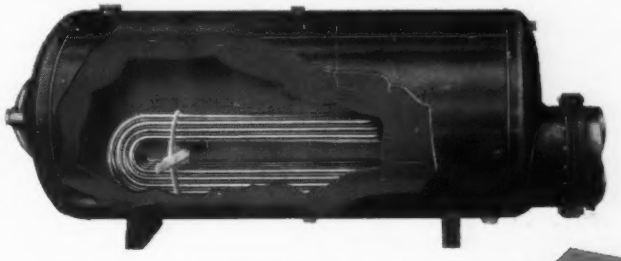
Plain steel plates soon lose protection, due to cracking and chipping. Cracks create localized corrosive cell spots.

SPECIFY the only cement lining made exclusively for Storage Water Heaters...

P-K PRE-KRETE®

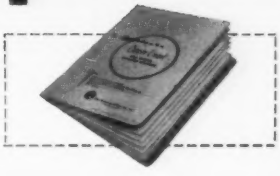
Every cement-lined storage water heater bearing the P-K name-plate is factory-lined with Pre-Krete. Pre-Krete is completely uniform, without weak spots or "holidays," because it is thoroughly blended in special P-K equipment. It forms a strong, durable coating, ¾" thick, that prevents rust and corrosion, and provides high resistance to thermal shock. Pre-Krete will not chip, crack, or flake even at temperatures up to 900°F.

You get a comprehensive guarantee on every P-K Storage Water Heater



Every P-K Pre-Krete Lined Storage Water Heater is fully lined including manhole, cover plate and heating element nozzle.

Specify P-K Pre-Krete lined and you get a storage water heater on which all materials and workmanship are fully guaranteed to be first-class in every respect, and you have the P-K assurance that every heater bearing its name will heat its rated capacity of water. For full details, write for your copy of Catalog Number 19 to Patterson-Kelley, 2503 Warren St., East Stroudsburg, Pennsylvania.



2

Patterson Kelley
Water Heater Division

storage water heaters • instantaneous heaters • convertors • water to water exchangers

For more facts circle 254 on Reader Service Card, p 122

Where to use Butterfly Valves

The field of use for rubber seat butterfly valves is broad, comprising the handling of large volumes of liquid or gas at pressures up to 125 psi. and at temperatures from —20°F to 190°F. Within this area, inherent simplicity of form and function in the butterfly valve give it great advantages over other types of valves.

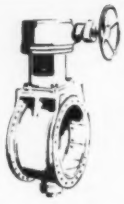
Henry Pratt butterfly valves are light in weight, compact and mechanically simple, factors that greatly reduce the kind of installation and maintenance costs that can be shockingly expensive in valves weighing a ton or more.

As you can see below, the great advantages inherent in butterfly valves have been multiplied, through Henry Pratt engineering, into a wide variety of practical, economical valving for standard operations as well as unusual problems in power and water works systems.

LOW PRESSURE valves are widely used in water works, power stations and industry where pressures range from vacuum to 50 psi. Pratt has built valves as large as 14 feet in diameter for wind tunnel use, and, for air circulation in nuclear power plants, valves that slam shut in 3/10 of a second.

COMBINATION VALVE AND EXPANSION JOINT combines two functions in one unit. This is economical both in material and installation costs because it eliminates one set of flanges and bolts. Units are built with rubber or steel bellows expansion joints.

HIGH PRESSURE valves are excellent for pump discharge-check applications and water distribution service. These valves have an upper pressure limit of 125 psi and velocity capability as high as 55 feet per second.

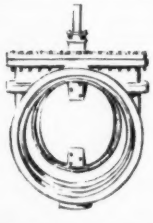


SPECIAL END VALVING. In some installations, such as water main service, flanged connections are not necessary, so both High and Low Pressure Pratt Valves are built with end modifications for bell-and-spigot piping and couplings such as Dresser or Victaulic.

ENDS OF PIPELINES or conduits. Single flange valves can be bolted directly to the end of a pipeline, conduit, settling basin wall or face of a reservoir. Functioning as sluice gates, they have the added advantages of permanent drop-tight shut-off with no need for adjustment or maintenance.

EXTRA LENGTH VALVING. Butterfly valves are often used for economical replacement of other valve types. As Pratt valves are relatively narrow, the laying length is increased by using a wider valve body or adding a spool piece.

LIMITED SPACE. Developed by the Henry Pratt Company, the Ob-Round valve makes it possible to obtain a desired valve area where space limitations prevent the use of a round valve. Ideal for basin or conduit applications.



INSERT VALVING. An original Pratt development that simplifies the replacement of gate valves by butterfly valves. The entire butterfly valve fits inside the gate valve body, saving the cost of removing valve body from the line.

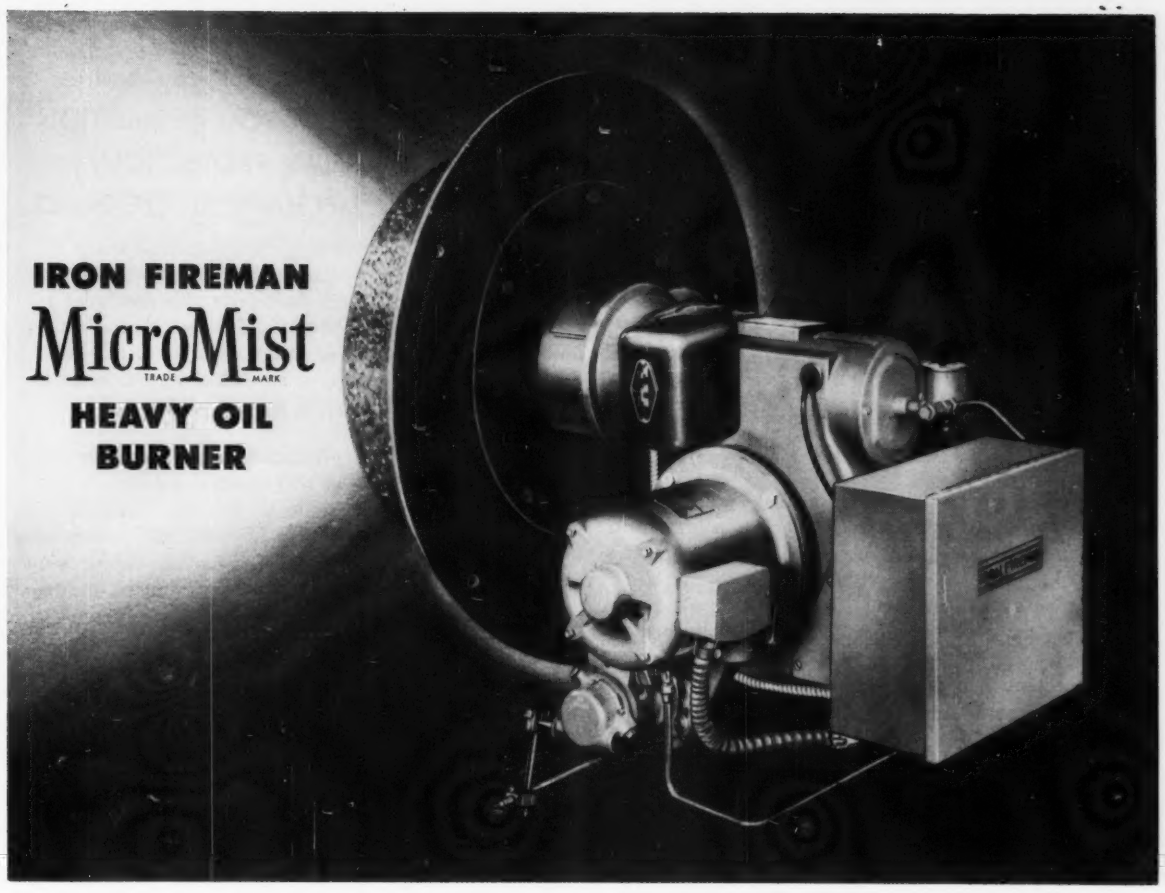
If you would like to know all about Henry Pratt valves, write for our Manual of Rubber Seat Butterfly Valves B-2K.

HENRY PRATT

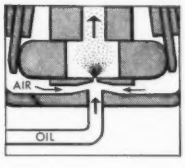
RUBBER SEAT Butterfly Valves

HENRY PRATT COMPANY, 2222 S. HALSTED ST., CHICAGO 8, ILL. • REPRESENTATIVES IN PRINCIPAL CITIES

For more facts circle 255 on Reader Service Card, p 122

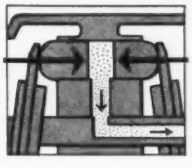


New way to fire low cost residual oil



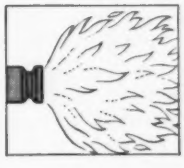
FIRST

The MicroMist burner makes an airborne oil spray. (This is as far as other burners go.)



SECOND

The airborne spray is compressed. Heat of compression further divides oil particles.



THIRD

Quick decompression of air-oil vapor makes an oil fog that burns with a clear, soft flame.

Residual fuel oils average 10 per cent higher in heat value, yet cost less than light heating oils

Small and medium size heating plants can now fire economy fuels with power plant efficiency.

The Iron Fireman MicroMist oil burner requires little more supervision than an ordinary domestic burner. Every essential component is built in—even the refractory firing throat. No secondary air supply, no refractory checker floor, no gas pilot. (Oil fog is readily ignited by an electric spark.)

The use of low cost fuel is not the only economy feature. Efficiency ratings are very high. Modulating flame accurately accommodates itself to variable loads, eliminating excessive on-off cycling. In modern sealed boilers no high stack is necessary. Maintenance costs are negligible. (Nozzle does not require cleaning.) *Any* grade of oil, from light heating oil through No. 5 fuel oil can be fired without burner adjustment.

The MicroMist burner can be applied to your present boiler, or ordered as a complete boiler-burner unit with compact Scotch boiler ready for service connections. Capacities to 25 gph.

Send for more information

IRON FIREMAN.®

AUTOMATIC FIRING EQUIPMENT FOR HEATING, POWER, PROCESSING

IRON FIREMAN MANUFACTURING CO.
3130 W. 106th Street, Cleveland 11, Ohio
(In Canada, 80 Ward Street, Toronto, Ontario)

Please send me more information and specifications on the Iron Fireman MicroMist burner.

Name_____
Firm_____
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City_____ Zone_____ State_____

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Technical briefs

Latest engineering developments for busy power men

20 papers for you on:
ELECTRICAL INSULATION
RELAY PROTECTION
MECHANICAL CLEANING

Users, manufacturers look at electrical insulation testing

The relationship between operating voltage and the standard dielectric tests for power and distribution transformers, *AIEE working group of the dielectric tests subcommittee of the AIEE transformers committee*

Present dielectric test standards for transformers result in inconsistent applications of insulation and protective devices. The industry should consider their revision. Revisions should be made if an overall industrywide benefit can be obtained. The form of possible revisions can be developed by answering the following questions: (a) Should the 500-kva dividing line between power and distribution impulse test levels be moved, if so where? (b) Should different dividing lines apply to various special classes of transformers, similar to that for secondary network transformers? (c) Should all impulse test distinction between power and distribution transformers be dropped? (d) Should the 18-kv class be made a part of the regular Dielectric Test Table? (e) How can differences of opinion, particularly on economics, be reconciled? *AIEE paper 58-1150*

Experience in analysis of dc insulation tests for maintenance programming, *F R Schleif and L R Engvall, U.S. Bureau of Reclamation*

Paper describes practical use of refinements in high-voltage dc insulation testing techniques within limits of test equipment, procedures found in U.S.

Analysis of dc insulation test data is beneficial because of (1) direct use of data obtained and (2) better understanding of the test, its characteristics, interpretation of results and practical control. Results indicate: (1) Absorption current component is a promising index of aging. (2) Tests should not be run above 30 C in order to avoid misleading results from extrapolation of absorption currents in test procedures. (3) Periodic tests and comparison of results yield the most sensitive indication of abnormalities. *AIEE paper CP 58-1312* (see *What's ahead for nondestructive electrical testing, p 210*).

The present status and anticipated progress in the field of insulating materials, *T D Callinan, International Business Machines Corp*

Author discusses briefly growth of dielectrics in the electric power, telecommunication and automatic detection and control industries. He concludes by looking at the present status of dielectrics and anticipates the direction of progress in the field. Paper lists nineteen references on dielectrics published in the last ten years. *AIEE paper 58-1208*

Results of motorette evaluation of insulation systems, *H P Boettcher, A O Smith Company*

Paper summarizes results of tests run according to the AIEE test procedures for motorette evaluation of insulation systems. These point up two conclusions: (1) Materials known to be different through experience are different in tests. (2) There is a reasonable correlation between test life results obtained for motors and those for motorettes. *AIEE paper 58-1280*

A utility's functional evaluation tests for high-voltage stator insulation, *A W W Cameron, M Kurtz, Hydro-Electric Power Commission, Ontario*

Paper is a progress report on research projects conducted by AIEE rotating machinery insulation subcommittee, the Canadian Electrical Association's apparatus section, manufacturers and utilities.

A voltage endurance test was chosen as most indicative of the ionization resistance which is considered critical in short-bore waterwheel generators, and a test of endurance of mechanical effects of thermal cycling was chosen as most applicable to insulation testing of steam turbine-generators and other long-bore machines.

Object, requirements, development of tests and test equipment are detailed. *AIEE paper CP 58-1311*

Relay protection

Operation of apparatus protective relaying at reduced frequencies, *AIEE working group on relaying during rotor prewarming of the AIEE generator protection subcommittee*

The practice of applying excitation to steam turbine-generators at speeds much below normal is increasing. Such operation at reduced frequencies raises the question of relay reliability.

Since most units getting this low-speed excitation are installed as generator-transformer units with a station service transformer but without a generator bus, report covers only this type installation.

Report discusses fault current during startup, current-transformer characteristics during startup and protection characteristics of ten generator and transformer relays. *AIEE paper 58-1224*

Relay protection practices in steam power stations, *H C Barnes, American Electric Power Service Corp,*

C S Murray, Consolidated Edison Co of New York, Inc and V E Verrall, Central Illinois Public Service Company

Report presents particular features of central-station protection emphasizing the problem of dependability and need for coordination of all protective devices in a station—mechanical as well as electrical.

Amount of protection, safeguards, generator protection, voltage regulators, turbine protection, transfer of auxiliaries, backup protection and maintenance are subjects covered. *AIEE paper 58-1106*

Excitation

Exciter response tests for exciters controlled by dynamic type voltage regulators, *V C Strode, General Electric Company*

A new method of testing exciter response is proposed using a delayed step-function voltage to represent transient output voltage of the voltage regulator. Test method would permit an exciter component test for exciters employed with dynamic type voltage regulators, and would represent the transient performance of an excitation system (if the transient output voltage of the regulator is known and can be simulated by a delayed step-function voltage). *AIEE paper 59-110*

Proposed excitation system definitions for synchronous machines, *AIEE working group on excitation system terms and definitions of the excitation systems subcommittee of the AIEE power-generation committee*

A regulated electric machine—generator or synchronous condenser—with exciter, regulator, rheostat and stabilizing elements is part of a feedback control system. To arrive at symbols and definitions for feedback control systems, a block diagram was set up to identify, define and describe concepts and relationships of the feedback control system.

Definitions in the report are based on a given diagram and work of Section Committee Y-10. Purposes of paper are to document proposed definitions and solicit industry comments. First section of paper presents proposed definitions; second section gives a brief explanation of why definition is proposed and provides a background for future action when definitions may be reviewed and possibly modified. *AIEE paper CP 59-179*

Performance of motor-driven exciters with Mag-A-Stat voltage regulators, *T J Bliss, M Enns, Westinghouse Electric Corporation*

Motor-driven main exciters are becoming increasingly popular in electric utility applications. If appropriately designed the motor-driven exciter is capable of performing equivalently to the direct-driven types. Certain functional requirements have been recognized as definitive of adequate motor-driven exciter performance for all but the most unusual applications.

Requirements are met by exciter sets having an inertia constant of 5.0 based on the kilowatt rating of the exciter if the drive motor has a breakdown torque of not less than 500% at a slip of 10%. *AIEE paper 59-109*

Power-equipment cleaning

Hydraulic jetting tools for cleaning heat exchangers, *B L Canaday, Dowell Division of the Dow Chemical Company*

Added to the mechanical and chemical cleaning methods for both interior and exterior cleaning of tube bundles and regenerative air preheaters is the high-pressure water jet.

Jet can be used with water only or, in those cases where needed, chemicals can be induced into the jet to aid cleaning action. For interior cleaning jet orifices are mounted in a jet head small enough to pass through the tubes. Heads can be self-propelled, being driven by backward-angled jets, or they can be mounted at the end of a lance.

Paper details operation on actual cases involving regenerative and tubular air preheaters and the tube and bundle side of refinery heat exchangers. *ASME paper 58-A-217*

Fouling and cleaning of power-plant heat exchangers, *C E Brune and T A Miskimen, American Electric Power Service Corporation*

Determining factor of heat-exchanger cleaning is economics. In discussing the problems of economic evaluation and of equipment design for certain cleaning operations, authors keep to unfired exchangers only, principally the tubular feedwater heaters of a modern steam plant.

Experience in chemical cleaning has led AEP to provide permanent facilities for chemical cleaning of all new units. Authors describe cleaning facilities included in station design, frequency of cleaning, types and locations of deposits, procedures employed, chemicals used for cleaning.

Use of digital computers helps determine the economic point of cleaning, cutting markedly the job of many calculations of small differences between heat-exchanger fouling effects on overall cycle efficiency and fuel bills. *ASME paper 58-A-289*

Trouble shooting mechanical dust collectors, *W E Archer, Western Precipitation Corporation*

Maintenance on most dust collectors involves keen observation and detective work. Since boilers stay on line and at higher loads longer today than ever before, minor signs of trouble in a dust collector can develop into major trouble before the next shutdown. Thus detailed inspection is vital.

Most common troubles come from poor gas distribution, plugged collecting tubes and wear. Ways to overcome these problems are illustrated by the author. He states, however, that maintenance of mechanical dust collectors can't be reduced to a formula and that a common sense approach must be combined with a thorough knowledge of fundamental operating principles of the units. *ASME paper 58-A-283*

continued

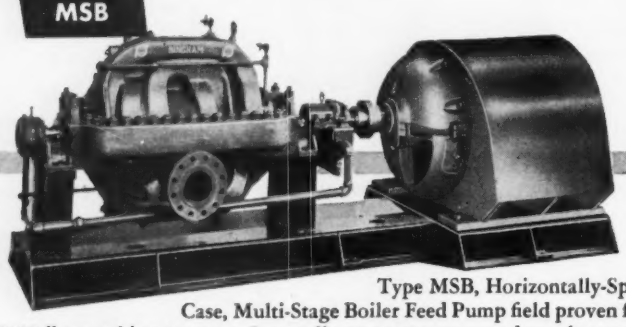
Specify

Bingham

"DOUBLE VOLUTE"
BOILER FEED PUMPS

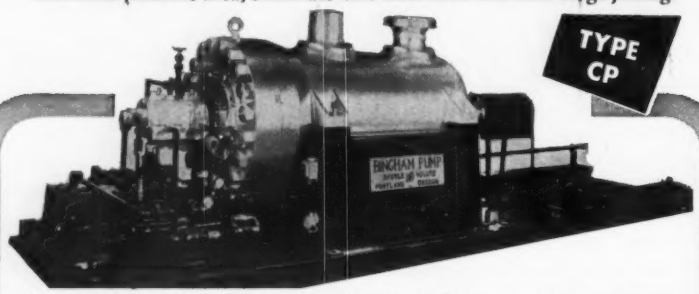
for the ultimate in dependability
IN HIGH PRESSURE SERVICE

TYPE MSB



Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.

TYPE CP



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Technical briefs

Begins on page 108

Hydraulic

Deriaz type reversible pump-turbine installation at Sir Adam Beck - Niagara forebay pumped storage project, *A E Aeberli, Hydro-Electric Power Commission of Ontario, Ontario, Canada*

The adjustable blade, single-speed, vertical, single - runner reversible pump-turbine units recently placed in service at Ontario Hydro's forebay storage-pumping station at the SAB Power Project on the Niagara River operate under unusual variations in head. In the pumping sequence limits are between 59 and 90 feet and in the turbine cycle from 45 to 85 feet. Tailwater depression is not required on startup, and changeover from turbine to pumping operation is accomplished in a matter of minutes and occurs several times a day.

Since many engineering features of the forebay reservoir and the two main power stations have been well described in recent papers, the author deals particularly with certain mechanical and hydraulic features of the reversible pump - turbine equipment installed in the pumped-storage station. *ASME paper 58-A-77*

Reversible pump-turbines for Sir Adam Beck - Niagara pumping generating station, *P Deriaz, English Electric Co, Ltd, Rugby, England, and J G Warnock, English Electric Canada, a division of John Inglis Co, Ltd, Ontario, Canada*

Authors describe the origin of the new machine and its application to the storage scheme at Sir Adam Beck-Niagara where it operates as a reversible pump - turbine. Description is given of its hydraulic characteristics and of some of the more important mechanical design features. This paper differs from No. 58-A-77 in concentrating more on reasons for the design, presenting less data on the station and forebay. *ASME paper 58-A-108*

Free discharge through a turbine distributor, case and draft tube, *R A Sutherland, Ebasco Services Inc*

The Pelton Hydroelectric Development of the Portland General Electric

Directions for ordering papers on page 114

Introducing . . . .

Another New D.T. Williams Valve

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The Figure 65 Swing Check Valve is another in the broad D. T. Williams line sold through Williams distributors. It is a high quality valve and features a seat which can be re-ground while the valve is still installed in the line. Like the other Williams valves, it is built with quality in mind. It is a dependable "guardian of the pipeline."

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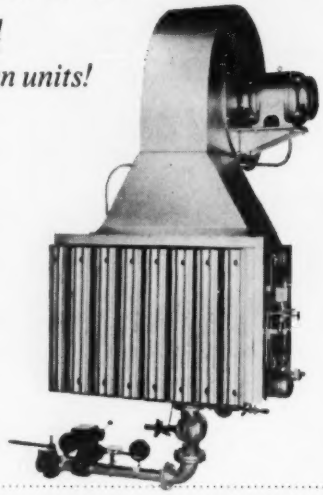
With the Coen packaging concept, you get distinct engineering, installation and operating economies. Coen completely engineers the unit to meet operating conditions. Installation can be made by your own maintenance force. Operation is simple, safe and efficient.



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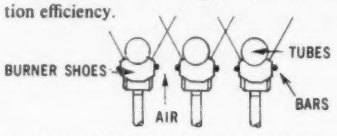

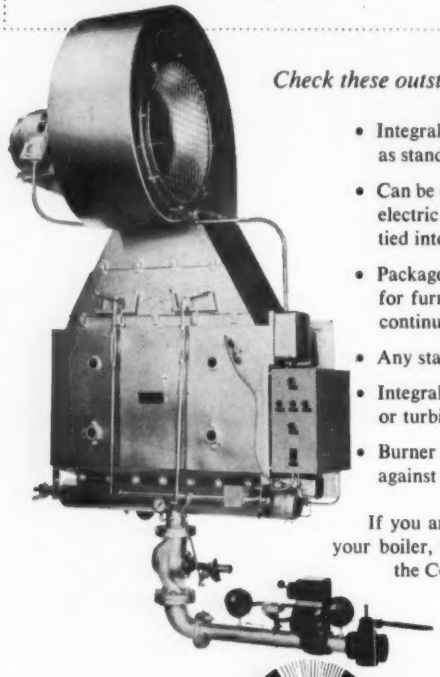

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Technical briefs

Begins on page 108

Co on the Deschutes River, Oregon consists of a 204-ft high thin arch dam, a three unit powerhouse (each unit of 32,400 kw at 152-ft head) and a re-regulating dam about three miles downstream from the power dam used to smooth out nonuniform discharge from the powerhouse.

Fish conservation made necessary a free discharge of 2500 cfs at all times in the river below the re-regulating dam. This meant releasing discharge through one of the units not yet complete until the reservoir filled to spillway level after closing the diversion tunnel.

After flow started through unit for free release, a vacuum between 15 to 20 in. Hg developed under the head cover and noise in the draft tube was considerable. Replacing valve on air pipe with a flared elbow raised vacuum to 5 in. Hg or less and reduced (but didn't eliminate) noise. *ASME paper 58-A-76*

Steam generation

Graphitization failures in piping, *J B Nuchols and J R McGuffey, Union Carbide Nuclear Company*
In September 1957, the Oak Ridge Gaseous Diffusion Plant power station experienced two major pipe failures brought on by graphitization. Paper describes what happened and why, pointing out the hazard still present for the power industry where comparable piping systems are operating with carbon-moly steel. *ASME paper 58-A-56*

Effect of steam-turbine reheat on speed-governor performance, *C Concordia, General Electric Co*
Until the introduction of the reheat cycle, the dynamics of the governing system were not considered important. Time lags were small and load disturbances have become small relative to system size.

Use of reheat turbines introduces a time lag of several seconds, and the effect of this is analyzed in this paper. Studies on effect of reheat on turbine speed-governing systems point out use of reheat (a) decreases damping of frequency variations of power system as a whole (b) greatly increases maximum frequency devia-

Directions for ordering papers on page 114

MOLYKOTE® LUBRICANT POWER NEWS

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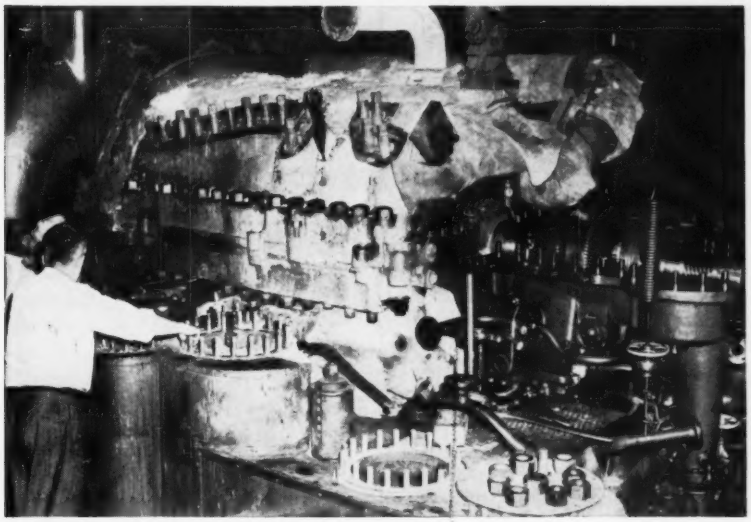
MOLYKOTE TYPE G IS BEST THREAD LUBRICANT AVAILABLE



Hundreds of threaded connections in a turbine are subjected to temperatures which may go as high as 1100°F.

Every power engineer realizes that the extreme bearing pressure in a threaded connection is carried at a series of contact points on the mating surfaces of the threads. The number of these contact points increases with load. Since these contact points are not spaced symmetrically about the thread circumference, off-center loads increase the severity of the contact pressures and frictional conditions.

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MOLYKOTE exhibits the lowest coefficient of friction of all solids at extreme bearing pressures and offers the highest resistance against galling and seizing. Because of its strong affinity for attachment to metal, it cannot be wiped off. MOLYKOTE used in threaded connections remains effective at temperatures in excess of 1100°F. The saving in damage to threaded connections in the power industry runs into fantastic figures.

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REPRINT AVAILABLE

"SOLID LUBRICANTS . . ." *an 8-page reprint from the Nov. 1958 issue of POWER, is available until supply is exhausted.*

MOLYKOTE TYPE Z UNAFFECTED BY RADIATION

Used in Critical Areas of Latest Nuclear Power Plants for Lifetime Lubrication

The nuclear power plant has complicated lubrication problems. Not only must lubricants operate over a wide temperature range, but they must be unaffected by radiation and, in many cases, must provide lifetime lubrication because of the inaccessibility of parts and the danger involved in servicing reactors.

More than a decade ago, scientists working for the Atomic Energy Commission discovered that MOLYKOTE Type Z was unaffected by radiation and they used it to lubricate equipment subjected to intense radiation. During the development and testing of nuclear power plants for atomic submarines, MOLYKOTE Type Z was specified by the designers and used extensively.

Today, more than ever, with the development of atomic reactors for the power industry, more emphasis is being placed upon the vital quality of lifetime lubrication and MOLYKOTE is being called upon to play a part which is continually increasing in importance.

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Technical briefs

Begins on page 108

tion after an abrupt load change (c) increases damping of high-frequency power oscillations on system tie lines. *ASME paper 58-A-36*

A combined steam gas-turbine cycle to use coal, *R W Foster-Pegg, Alco Products, Inc*

Problems involved in operating a combined steam-gas turbine power plant on coal as well as a cost estimate of a method not previously mentioned are looked at here. Volatile parts of coal are continuously separated from char by carbonization. Gases are then burned in the turbine and the char burned in boiler of a plant working on exhaust-heat-recovery cycle. Most of the thermodynamic improvement, normal for the exhaust-heat-recovery cycle when using clean fuel, is gained using coal this way. Capital costs should not be more than those of a conventional plant. *ASME paper 58-A-174*

A new performance criterion for steam-turbine regenerative cycles, *J K Salisbury, consulting engineer*

Author explains use of flow-weighted average extraction enthalpy as a criterion combining in one variable all effect of extracting steam for feedwater heating, and indicates how it permits quick estimation of heat rate change on the cycle. It is therefore useful in both design and monitoring performance of the thermal cycle, as well as estimating cycle improvement by regeneration. *ASME paper 58-A-205*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

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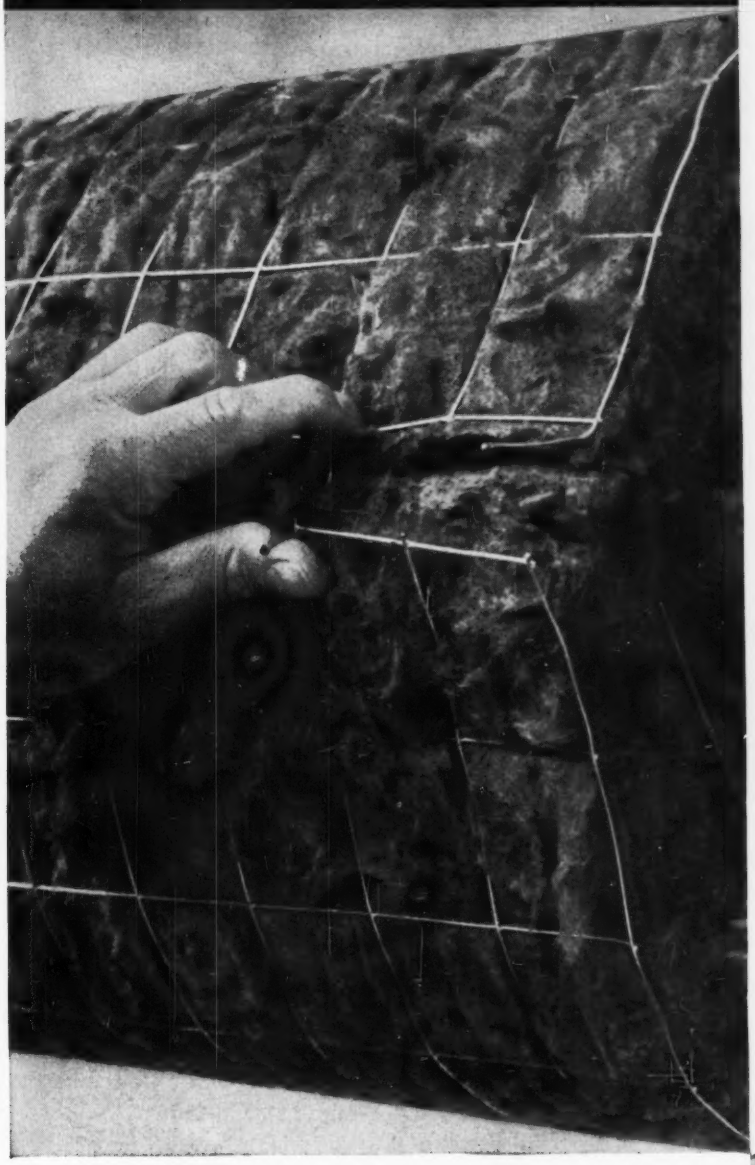

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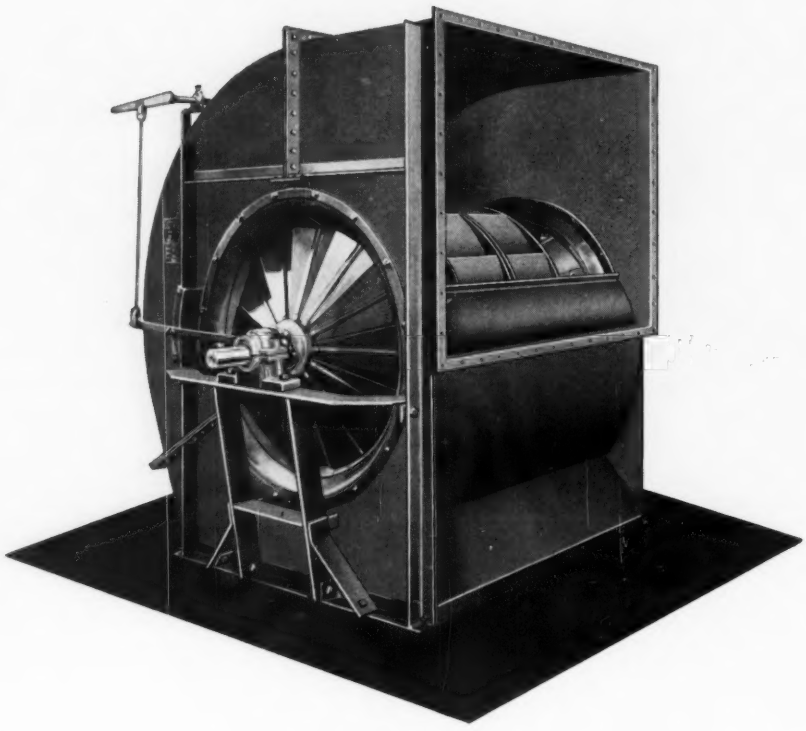

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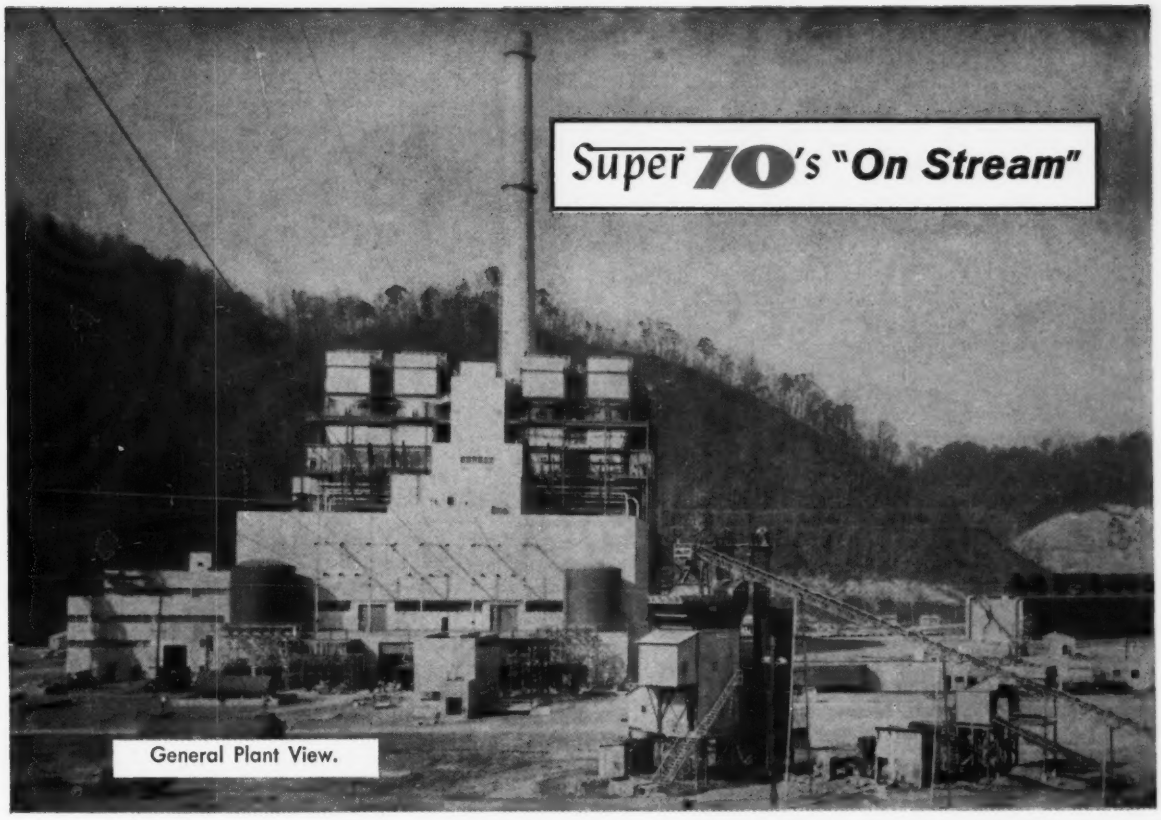
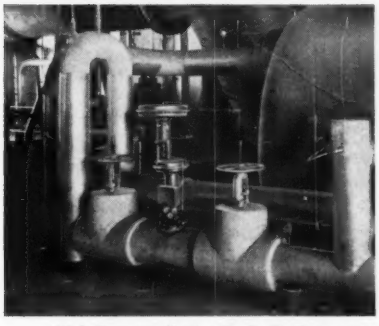
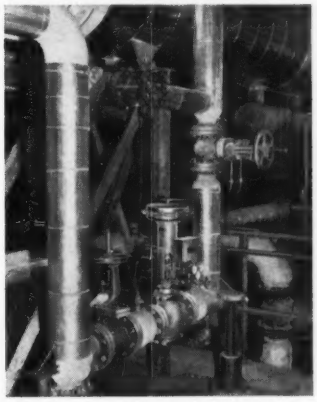


General Plant View.

Clinch River Plant, Units 1 & 2



High Pressure Heater Drain To Deaerator.



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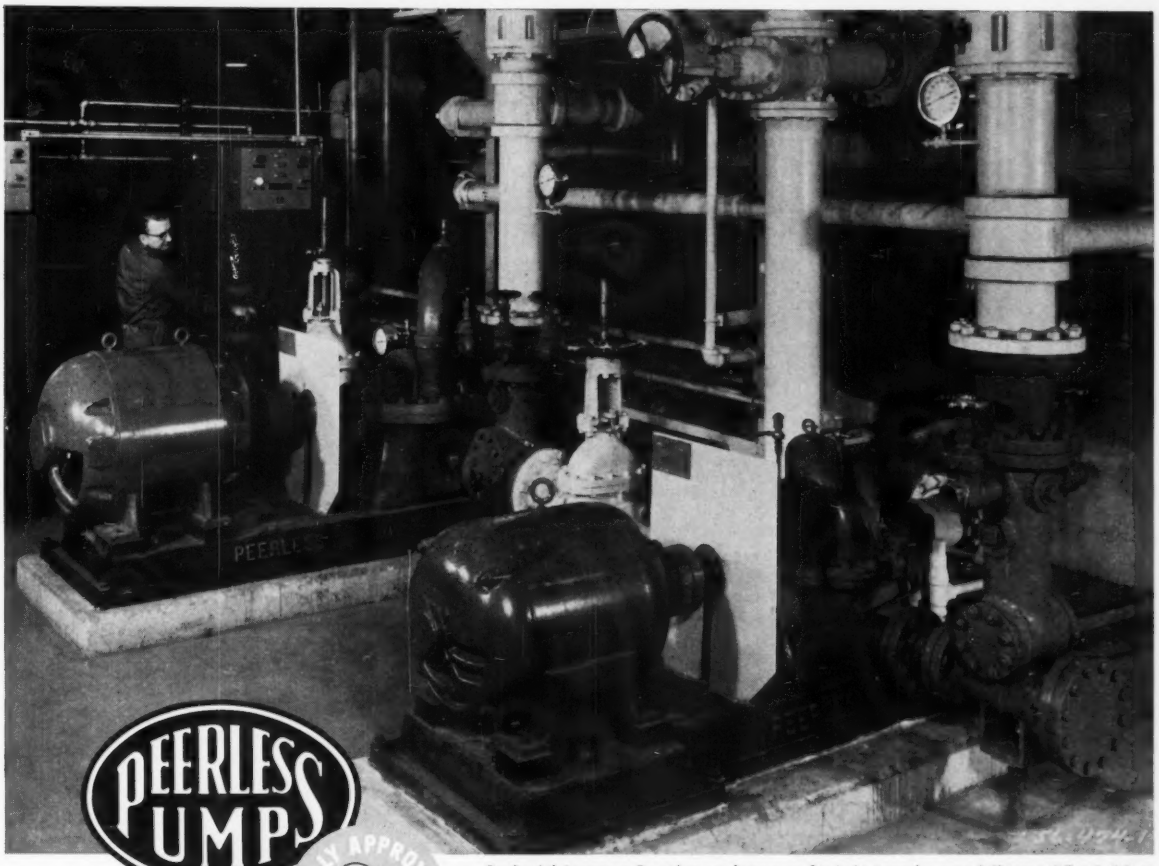

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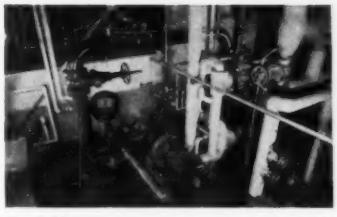

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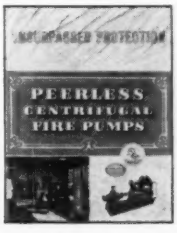

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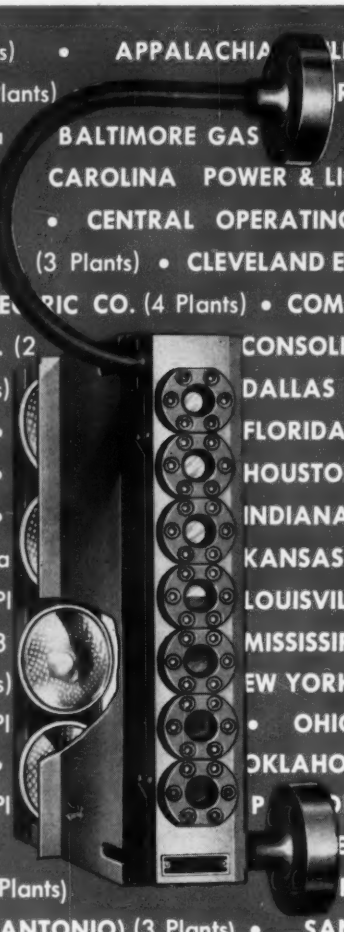

Model MP-3000 shown is for both new and old boilers having pressures to 3000 psig. Also available in Model MP-900 for boiler pressures to 900 psig.

8266

Undoubtedly the best recommendation for the Diamond "Multi-Port" Gauge is the public utilities that use it and have placed repeat orders to equip additional boilers. A few of these are mentioned here with a note of the number of plants equipped. For the many advantages of the "Multi-Port", ask your local Diamond office or write directly to Lancaster for Bulletin 1174 (Model MP-3000) or Bulletin 2044 (Model MP-900).

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New free literature

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AIR CONDITIONING, HEATING AND VENTILATION

101 **Vibration control** for air conditioning is subject of 4-p bulletin VAC-12. Vibration mounting selection guide is cross-indexed according to equipment type. Vibration Mountings, Inc

102 **Hot-water heating coils** for zone or central air-conditioning systems are discussed in 2-p bulletin HWC-200. Dimensional data is given on finned coils. Halstead & Mitchell

103 **Roof ventilators,** centrifugal type, are topic of 8-p brochure 4004. Design, construction features of 13 basic sizes are listed. American-Standard, American Blower Div

104 **Automatic air filter** with renewable media is described in 12-p bulletin 248-C. Construction and operation are explained, illustrated. Gives dimensions, capacities. American Air Filter Co, Inc

105 **Rigid plastic fans,** corrosion-resistant, centrifugal and twin-flow models, are featured in bulletins 9-20 and 9-21. Diagrams, performance tables are given. Atlas Mineral Products Company

MATERIALS

106 **Engineering properties** of austenitic ductile irons is topic of 28-p booklet. Tables and graphs explain physical properties, erosion and corrosion resistance. The International Nickel Co, Inc

107 **Silicone applications** are covered in 16-p guide. Graphic examples show how to use over 150 silicone products available. Dow Corning Corporation

108 **Polyurethane elastomer** is described in a 24-p booklet. Graphs, charts and photos cover physical, chemical, electrical, thermal data. Disogrin Industries, Inc

109 **Definitions** of brass-mill product terminology are given in 24-p copper, copper-alloy dictionary. The American Brass Company

COMPRESSORS AND ACCESSORIES

110 **Air compressors** are covered in 12-p bulletin SG-2. Single- and 2-stage units from ½ to 15 hp, 80 to 250 psi are described, illustrated. Westinghouse Air Brake Co, Le Roi Div

111 **Prefilters** for compressed-air and -gas systems are discussed in 2-p bulletin R-35. Includes uses, operation, design features. Desomatic Products, Inc

112 **Dry, clean air** at constant pressure is provided by air rectifier, topic of 2-p spec sheet. The Lawrance Engineering Co

MATERIALS HANDLING

113 **Materials-handling** procedure improvement through use of pneumatic equipment arranged in systems is discussed in 12-p ASME reprint. Fuller Company

continued

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March 1959 issue

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PLANT EQUIPMENT in the news this month, starting on p 132

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NEW FREE LITERATURE continued. . . . . circle key numbers, page 122, for your copies

114 **Ship-to-shore** coal handling at one ton per sec is described in 4-p bulletin 1157. Stephens-Adamson Mfg Co

115 **Crusher** with ring-type double rotor is described in 4-p bulletin 858. Action photos illustrate unit. Stephens-Adamson Mfg Co

116 **Belt-conveyor idlers** are described in 40-p book 2716. Detailed engineering selection data on 14- to 84-in. units are given. Link-Belt Company

117 **Car-shaking unit** is subject of 6-p folder 658. Photos, diagrams and drawings illustrate operation. Stephens-Adamson Mfg Co

ELECTRICAL GENERATION AND TRANSFORMATION

118 **Generators,** ac type, are listed in 16-p catalog ACG958. Construction, sizes, performance of brushless alternators are featured. Kato Engineering Company

119 **Transformers,** dry and liquid-filled, are topic of loose-leaf catalog. Marcus Transformer Co, Inc

120 **Storage batteries** of heavy-duty nickel cadmium for engine starting, standby power applications are subject of 4-p bulletin 200. Gould - National Batteries, Inc, Nicad Div

121 **Regulator** for direct voltage control of main fields of large alternators and generators, line load regulation, power amplification is topic of 6-p bulletin 6.04. Electric Regulator Corporation

122 **Distribution regulator,** 3 - phase model, is covered in 6-p folder 21B9026. Allis - Chalmers Manufacturing Company

ELECTRICAL DISTRIBUTION, PROTECTION AND APPLICATION

123 **Isolated-phase bus** is detailed in 12-p bulletin GEA6874. Features, applications are shown with photos, cutaway and line drawings. General Electric Company

124 **Metalclad switchgear,** 4.16 - kv horizontal-drawout model, is described in 12-p bulletin 18B6346C. Indoor and outdoor types are available. Allis-Chalmers Manufacturing Company

125 **Industrial electrification system** using steel - enclosed 100 - amp trolley busway is covered in 44-p bulletin 75. Accessories for powering moving equipment are illustrated. Feedrail Corporation

126 **Silicones** to reduce insulator flashovers and cut cleaning time are discussed in 6-p leaflet 4-215. Dow Corning Corporation

127 **Low-voltage power protector** is detailed in 8-p bulletin GEA-6527. Designed for heavy-duty use in commercial buildings, unit operates at 480-v ac and below. General Electric Company

128 **Ac magnetic starters** are the topic of 16-p booklet EN-150. Component units, elements are covered. Cutler-Hammer Inc

129 **High-voltage control** is discussed in 16-p booklet EN-162. Control for squirrel - cage, synchronous and wound-rotor motors is covered. Cutler-Hammer Inc

130 **Industrial lighting** fixtures, color-coded for identification, are subject of 8-p brochure. Accessories are also listed. Edwin F Guth Company

INSTRUMENTATION

131 **Flame safeguard** is topic of 2-p spec sheet. Construction, opera-

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NEW FREE LITERATURE continued.....circle key numbers, page 122, for your copies

tion, applications are detailed for the self-checking unit. Minneapolis - Honeywell Regulator Company, Industrial Div

132 **Electronic instruments** in indicating, recording and controlling models are listed in 64-p bulletin P1245-A. One section describes incorporation of units into other makers' equipment. The Bristol Company

133 **Combustion indicator** and recorder is covered in bulletin 802. Schematic diagrams show installations and relay circuits. ESS Instrument Company

134 **Temperature detection** at low cost is subject of 30-p catalog 3036C. Accessories are described. Thomas A Edison Industries, McGraw-Edison Company, Instrument Div

135 **Moving temperature probe** to patrol critical boiler gas passages and warn of incipient hot spots during lighting off is discussed in 4-p bulletin 1048. Blaw-Knox Company, Copes-Vulcan Div

136 **Rotameter** flow-rate transmitter is described in 12-p booklet 170. Brooks Rotameter Company

137 **Portable digital indicator** and force calibrator is covered in 2-p spec sheet D-103. Gilmore Industries, Inc

138 **High-speed printer system** for computers, with automatic editing, built-in checking, is discussed in 4-p brochure 5221. Burroughs Corporation

139 **Data-processing equipment** for a broad range of functions is listed in brochure U-1363. Sperry Rand Corp, Remington Rand Div

140 **Industrial TV cameras** are illustrated in 4-p bulletin. Specs are given for standard and high-noise-level units. Cohu Electronics, Kin Tel Div

141 **Thermowell material** is covered in 4-p guide. Includes materials for 325 applications. Thermo Electric Co, Inc

142 **Bin-level control switches** in normal, explosionproof and heavy-duty styles are described in 4-p bulletin 11-0. Stephens-Adamson Mfg Co

143 **Liquid-level gages,** remote-reading models, are included in 8-p catalog 338. Operation and application data are featured. Jerguson Gage & Valve Company

144 **Flow indicator,** clearly visible from a distance, is described in 4-p data sheet. Unit is useful with circulating water or oil. McIntosh Equipment Corp, Walker Crosweller Div

MAINTENANCE

145 **Cleaning** of heat-exchange bundles with high-pressure jetting tool is discussed in 2-p service bulletin. Dow Chemical Company, Dowell Div

146 **Impulse testing** of distribution transformers is described in 4-p brochure. Charts show typical impulse wave shapes caused by failures. H K Porter Company, Inc, Delta-Star Electric Div

147 **Plastic laminate** used to fabricate weather-resistant printed signs and charts is topic of 2-p spec sheet. Duralith Corporation

148 **Wire-rope service life** can be extended by proper inspection program. Service bulletin 104 tells how. H K Porter Company, Inc, Leschen Wire Rope Div

continued

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facts about Superior Packaged Boilers

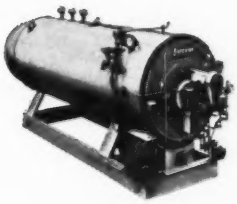
SUPERIOR'S MID-SHELL FURNACE LOCATION

protects against the two most common causes of furnace failure

One of the often overlooked, and yet very important considerations for the purchaser or specifier of boilers of the horizontal fire-tube type is the location of the furnace in relation to the boiler shell. To a great extent this location is determined by whether the boiler is of the up-draft or down-draft type. Up-draft units usually have the furnace set low inside the shell. Down-draft units usually have a higher furnace location.

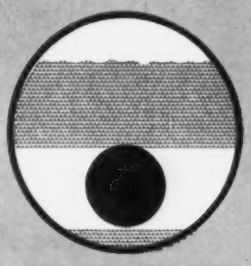
Ideally the furnace is located near the center of the shell, where it is protected from the two most common dangers which can cause bagging, blistering or complete burnout of the furnace.

The first of these dangers is low-water. When the furnace is located too high in the shell, the covering layer of water is necessarily less, and the danger is increased. When the furnace is too low within the shell, mud and silt can deposit on the bottom of the shell and eventually bridge to the bottom of the furnace, cutting off circulation and causing a burnout of the furnace. The adjacent diagrams show the location of the furnace in other fire-tube boilers and in Superior Type C boilers. When you buy or specify a packaged fire-tube boiler consider this important fact.

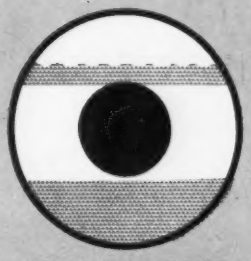


SUPERIOR "TYPE C"
PACKAGED BOILERS

Completely packaged fire-tube units for capacities from 20 to 350 bhp. Rotary burners on all sizes. Induced draft for clean, quiet safe operation. Fully insulated and ready for service burning oil, gas or both in combination. Pressures to 250 psi, or for hot water operation. Other fire-tube models for capacities to 600 bhp. Write today for Bulletin 11C.



LOW FURNACE...MUD BURNOUT DANGER



HIGH FURNACE...LOW WATER BURNOUT DANGER

MID-SHELL LOCATION GUARDS AGAINST BOTH

Specialists in **PACKAGED BOILERS**... exclusively

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SUPERIOR
PACKAGED BOILERS

For more facts circle 266 on Reader Service Card, p 122

PLASTIC PIPE AD WITH NO PICTURE?

Why no picture: Because almost all plastic pipe looks the same. You know yourself that looks can be mighty deceiving, and piping that goes wrong can be mighty expensive. A picture means nothing... but...

There are scores of brands of plastic pipe on the market... made of a dozen different kinds of materials. Most of it is labeled "corrosion-resistant" but the results may be good, bad or indifferent depending on your choice. A picture is no help. Here's what to look for instead:

The universal material? No such thing. No one plastic can handle all liquids and gases... no one has *all* the physical properties required of a truly universal pipe. Closest to it are Ace Riviclor (Rigid PVC) and Ace-Ite (rubber-plastic blend). The former is a little better on chemical resistance, the latter is a little better on impact strength and heat resistance. Both same price.

Are plastics strong enough? Thousands of chemical plants say "yes". Pipe is now available in several wall thicknesses... in flexible tube sizes (Ace-Flex clear transparent), up through gas-tubing sizes (Ace-Ite and Ace Riviclor), through flexible Supplex polyethylene pipe, and Schedules 40 and 80 rigid plastic pipe for pressures up to 490 psi.

Above that, there's Ace rubber-lined steel pipe. And don't forget Ace soft-rubber-lined pipe for resistance to abrasion.

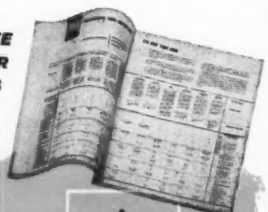
Where do I use it? For corrosive chemicals and gases of all types. The only ones that are difficult are certain solvents and chlorinated aromatic hydrocarbons, and if you're careful to pick the right *one* of the *many* Ace materials, you can even handle most of these tough corrosives. Use plastics, too, for water lines, gas lines, electrical conduit, etc., or any lines where the pipe passes through corrosive vapors or damp areas, or goes underground.

Is there a plastic for hot corrosives? Yes, Ace Tempron, which is good to 275 deg. F. with most chemicals. Stays chemical resistant, strong, and rigid where other plastics may be attacked or may sag.

How can I dodge "trial and error"? Go to a company that has no axe to grind. We, for instance, make no less than nine different kinds of pipe ... with fittings and valves to match... and give you thoroughly unbiased advice backed by 100 years of experience and prices as low as you'll find anywhere.

FREE SELECTOR CHARTS

20 valuable pages... comparable properties, chemical resistance, costs, etc. of 11 plastics and rubber materials Write today for Bulletin CE-50.



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Division of Amerace Corporation
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Free literature

Begins on page 121

MECHANICAL POWER TRANSMISSION

149 **Coupling catalog** has 24 pp, lists specs and engineering info. Dominion Engineering Company Limited

150 **Precision gears** from 1- to 200-in. dia are described in 24-p bulletin GEA-6430. Gear-testing devices, high-speed flexible couplings are also covered. General Electric Company

151 **Integral-shaft sheaves** for low-cost stepless speed control in large machine drives are topic of 6-p folder 20B7897B. Allis-Chalmers Manufacturing Company

PUMPS

152 **Utility pumps** with helical screws are covered in 8-p catalog. Only moving part in the pumps is a rubber stator. Continental Pump Company

153 **Pumps** for water and nonabrasive liquids up to 70,000 gpm are listed in bulletin B-1300. Cutaways, cross-sections describe units in detail. Food Machinery and Chemical Corporation, Peerless Pump Div

154 **Proportioning pump** for general industrial fluids is topic of 2-p spec sheet 1106.20A1. B-I-F Industries, Inc

STEAM GENERATION

155 **Packaged boilers** are covered in 4-p brochure PG-58-2. Features, standard and optional equipment and dimensions are listed. Foster Wheeler Corporation

156 **Torch burners** are described in 2-p data sheet 1A-9. Capacity tables, specs included. Bryant Industrial Products Corporation

PRIME MOVERS

157 **Turbine-generators** from 5000 to 100,000 kw for industrial and electric-utility applications are subject of 40-p 4-color booklet B-7373. Well-illustrated sections cover turbine and generator. Diagrams show hydraulic governing system. Westinghouse Electric Corporation

158 **Combustion gas-turbine** applications in the refining industry are described in 12-p bulletin 166. Pump and compressor drives, power generation, emergency uses are discussed. Clark Bros Co

VALVES, PIPING FITTINGS AND SPECIALTIES

159 **Refrigeration valves,** fittings and supplies are listed in 32-p catalog. Tables on refrigerants, brines, steel pipe, copper and steel tubes make up an 8-p section. Frick Company

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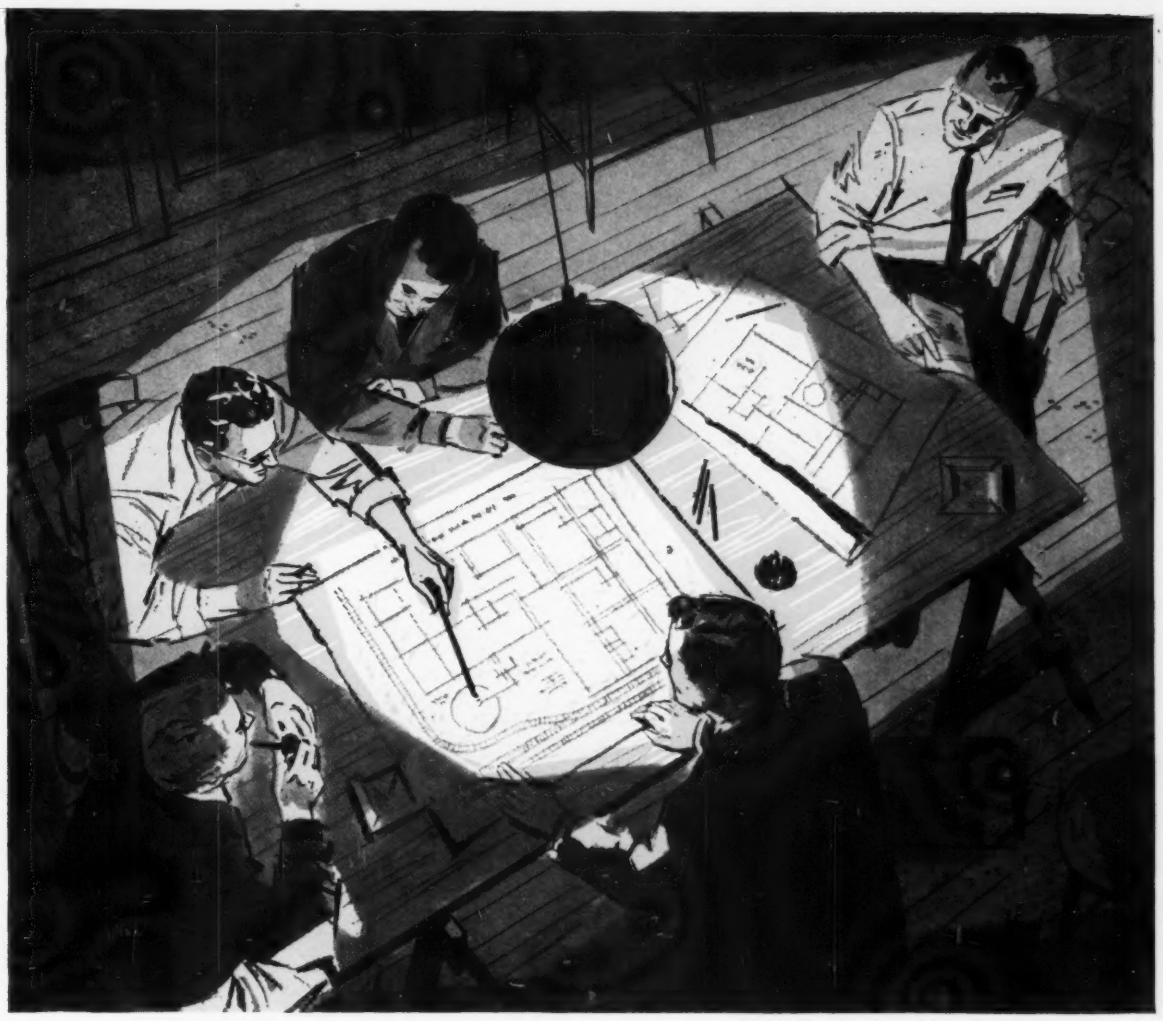

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The Morton Consulting Engineers have experience with all types of water softening systems for all types of uses. The assistance they offer is well worth an inquiry. If you think a Morton Consulting Engineer could be of assistance to you, just send in the coupon today.

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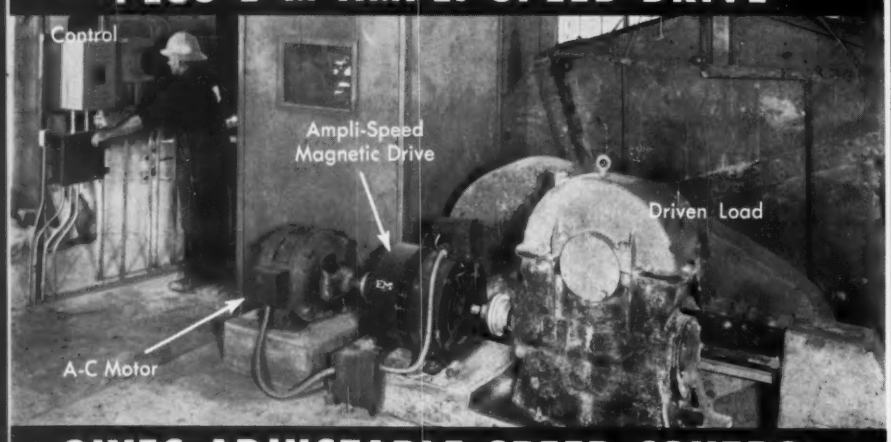
PLUS E-M AMPLI-SPEED DRIVE



GIVES ADJUSTABLE SPEED CONTROL

. . . it's that easy to have precise, adjustable speed control on fans, compressors, centrifugal pumps, conveyors, a-c frequency stabilizers, machine tools, etc.

Ampli-Speed is a simple, compact magnetic slip coupling that is:

EASILY ADAPTED – it may be either belted or coupled to your motor and load.

SIMPLE TO INSTALL – it's air cooled and can be handled and installed just like a motor.

EASY TO CONTROL – speed is changed by simply turning control potentiometer . . . output may be controlled automatically, too, by pressure, level, or combustion devices.

Ampli-Speed has nearly stepless speed change and gives speed regulation within ± 2%. It's available in these integral horsepower ratings: thru 310 hp for variable torque loads; thru 75 hp for constant torque loads. Input speeds can be 860 thru 1750 rpm.

WRITE FOR FREE LITERATURE – Illustrated publication No. 243 tells how Ampli-Speed works and how to select right model from easy-to-use charts. Write the factory for your free copy and see your nearby E-M Sales Engineer for expert help with speed control.

Somewhere in your plant an operation can be improved with adjustable speed control . . . DO IT YOURSELF WITH AMPLI-SPEED

ELECTRIC MACHINERY MFG. COMPANY

Minneapolis 13, Minnesota

Free literature

Begins on page 121

160 **Expansion joints** and flexible couplings of rubber, neoprene, Teflon-lined rubber are subject of 8-p bulletin EJ-1058. Sizes, dimensions, pressure recommendations are given. The Belmont Packing & Rubber Co

161 **Lightweight pipe,** fittings, flanges and connections are topic of 8-p bulletin 59. Naylor Pipe Company

162 **Tandem blowoff valves** for blowoff pressures to 665 psi are subject of 4-p bulletin B-435. Yarnall-Waring Co

163 **Pipeline noise control** with rubber pipe connections is discussed in 2-p bulletin RFP-10. Installation photos illustrate text. Vibration Mountings, Inc

164 **General-service valves** are discussed in 20-p bulletin E-165. Types, applications, construction, features are covered. Everlasting Valve Company

165 **Butterfly valves,** Class 125, are topic of 2-p bulletin 650.20-1. Cutaway drawings, photos are included. B-I-F Industries, Inc

166 **Cast monel** and nickel valves and their application to corrosive environments are described in bulletin 9. Chemical, mechanical properties are given, basic designs illustrated. Alloy Steel Products Company, Inc

167 **Pipe dimensions** and weights are listed in 4-p data card TDC-191. Covers pipe sizes from ⅛ to 36 in. The Babcock & Wilcox Company

168 **Flexible metal hose** for diesel installations is featured in 4-p data sheet 10-X-552. Charts and diagrams help tell the story. Allied Metal Hose Company

169 **"Tubemanship"** is discussed in 16-p brochure. Describes skills and techniques involved in making seamless copper and copper-alloy tubing. Calumet & Hecla, Inc, Wolverine Tube Div

170 **Tubing chart** explains method for calculating tube size needed to machine to a finished dimension. Peter A Frasse & Co, Inc

171 **Swing joints,** available with synthetic rubber O-rings, are covered in 12-p catalog F-8. Includes photos, diagrams, charts. OPW Corporation, Jordan Industrial Sales Div

172 **Plug-valve actuators** are described in 22-p brochure. Specs, dimensions and torque information are given. Pantex Manufacturing Corporation.

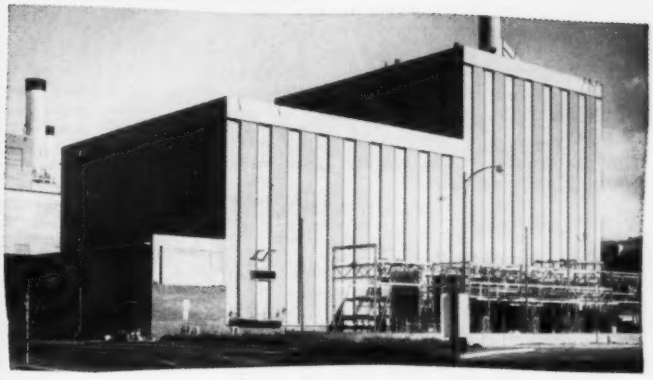
continued

◀ **circle 269 on Reader Service Card, p 122**

Maximum control of temperatures with **PABCO PRECISION-MOLDED CALTEMP** a Calcium Silicate Insulation

INSULATION GUIDE

Temperature	Recommended Pabco Insulation
to 550° F.	85% Magnesia pipe covering, block, cement
to 1200° F.	Caltemp pipe covering, block, cement
to 1800° F.	Pabco 13 C pipe covering, block, cement
to 1900° F.	Pabco 19 C block



Curb expensive heat loss, control temperatures within minimum tolerances with performance-proved Pabco Insulations.
For power plant piping and equipment, a Pabco Insulation insures peak performance wherever temperatures must be maintained up to 1900° F. Pabco's Caltemp and 85% Magnesia insulations are "Precision-Molded" by a patented process in both pipe and block form. For data on technical advantages . . . case histories . . . or engineering consultation, write . . . or call . . . a Pabco insulation engineer.

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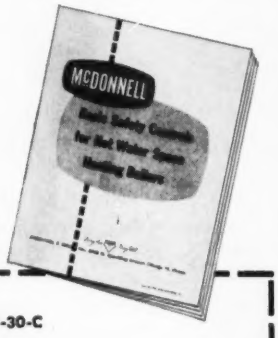
NEW BOOK THAT CAN DO A JOB FOR YOU!

Covers the WHY and HOW of Basic Safety Controls for Low Pressure Steam Boilers

Here is a book that deals in brass tacks solely. It tells its story in simple diagrams and equally simple explanation that wastes no words on product description. It sticks to fundamentals and concrete recommendations that answer practically all safety control problems encountered in the low pressure steam field. So well classified and indexed are the facts that, whatever your job, you can turn right to the most authentic way of handling it: The right product ... the correct hook-up ... the proper wiring. *Use the coupon to request your copy*, and if you do not have the earlier "hot water" booklet, request it too.

This new "Low Pressure Steam" booklet was inspired by the widely praised booklet on "Hot Water Boilers." These two companion-pieces can do a real job for you.



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Free literature

Begins on page 121

173 **Surge-relief valve** to protect water lines against overpressures is subject of 8-p bulletin W-2-A. Detailed drawings, suggested specs are included. Golden Anderson Valve Specialty Co

174 **Regulators** for liquid-level control system are covered in 4-p bulletin J-170. Installation and operation are illustrated. OPW Corporation, Jordan Industrial Sales Div

175 **Pressure-reducing valve** is topic of 2-p spec sheet JNP-1. Units come in 2½- and 3-in. sizes. OPW Corporation, Jordan Industrial Sales Div

176 **Gas regulators,** cylinder, manifold and station-pressure types, are listed in 36-p catalog ADC 705F. Flow and pressure specs, inlet and outlet connection dimensions are included. Air Reduction Sales ompany

177 **Solenoid control valves** with driptight closing are subject of 4-p folder 136. Photos, diagrams are included for the 160-psi ac and 100-psi dc units. Cla-Val Co

178 **Temperature-control valve** systems are topic of 4-p bulletin J-180. Systems control temperatures from 35 to 450 F. OPW Corporation, Jordan Industrial Sales Div

WATER TREATMENT

179 **Lab-supply** price list, 12 pp, lists water-analysis sets, conductivity equipment, colorimetric comparators. Betz Laboratories, Inc

180 **Dialysis system** that can treat acid liquors is covered in 6-p bulletin WC-121. Engineering drawings illustrate construction. Graver Water Conditioning Co

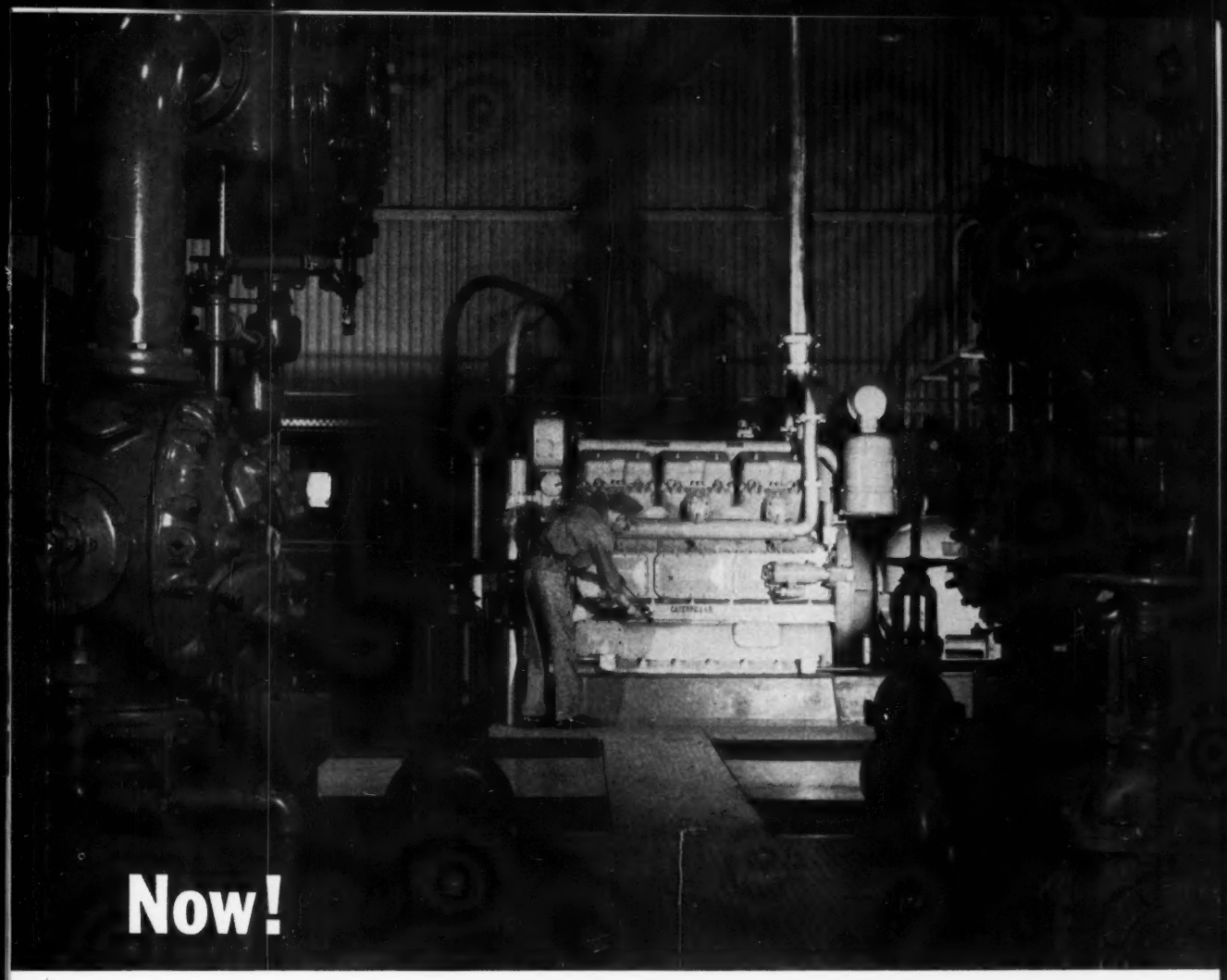
181 **Clarifiers** and thickeners for handling liquid-solids separation in water, sewage and industrial waste treatment are discussed in 16-p bulletin W-800. Low-, medium- and high-torque drives are illustrated. Infilco Inc

182 **Chromate test** eliminating all liquid reagents except sodium thiosulfate is discussed in analytical data sheet. Betz Laboratories, Inc

MISCELLANEOUS

183 **Industrial technology** is subject of 36-p pictures-and-text booklet. The history, present role and future potential of technology are covered. E I Du Pont de Nemours and Company Inc

184 **Engineering scale models** for piping and structure design are described in two bulletins. Industrial Models, Inc



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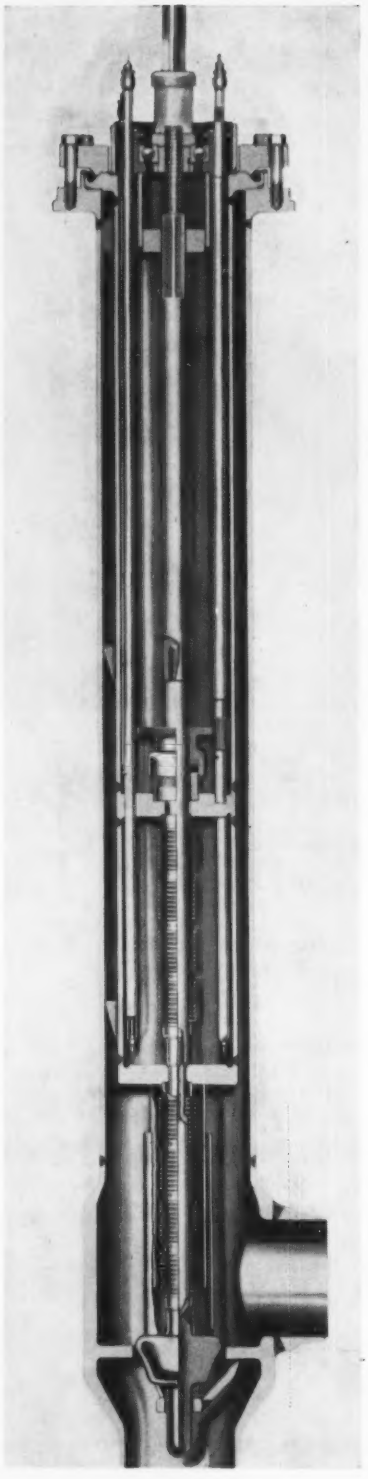
EXCLUSIVE

Equipment design of the month



On this page each month you'll see the wraps taken off a significant new product at least 30 days before it's released to any other publication, before it's advertised anywhere

By STEVE ELONKA, Associate Editor

Your first look at . . . the new canned control valve

Here's a new canned control valve for primary liquid-sodium coolant lines leading to blanket section of Enrico Fermi Atomic Power Plant. Three of these manually operated 6-in. valves are being used. Designed by Copes-Vulcan Division, Blaw-Knox Co, they serve as variable throttling orifices in blanket feed lines without complete shutoff. This allows flow to be regulated as needed, with no danger of closing, which would stop blanket coolant flow. Control range is 5 to 20% of total flow.

Entire inner assembly of valve is contained within a sealed container. It can be removed by an automatic manipulator as a unit without draining the system.

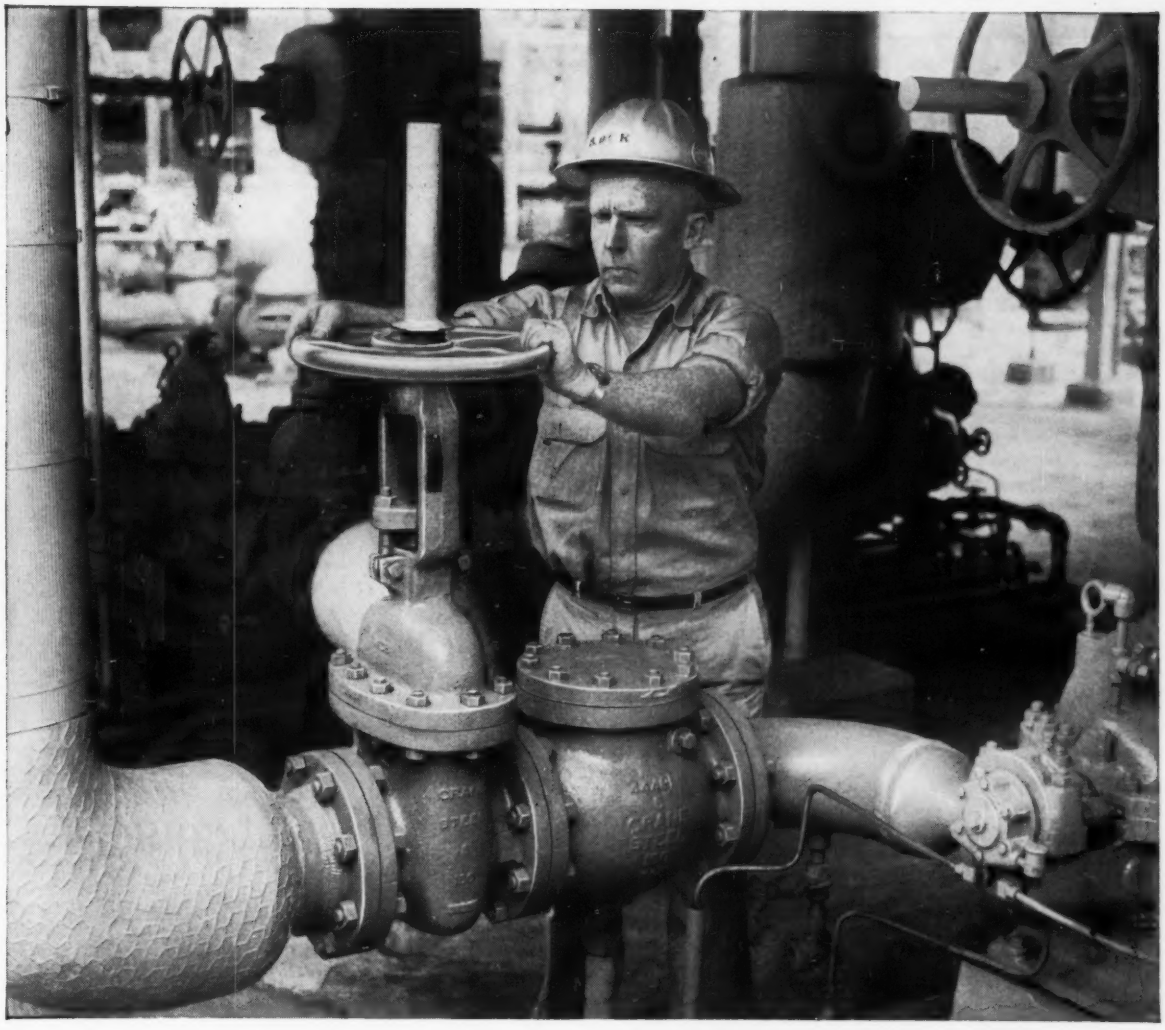
Assembly has two leak detection chambers, each fitted with an electrical detector. Openings in chambers through which the nonrotating rising stem passes are sealed by two long flexible bellows. Lower bellows is in sodium flow stream, so it's protected against pressure and erosion by a telescopic shield. Upper bellows is final guard against stem leakage and is backed by a packing gland. Valve stem has both a fore and back seat on lower chamber head.

Valves are made of 150 psi standard forged Type-304 stainless steel suitable for 1000 F. Throttling surfaces and stem guide are of stellite. Stellite ball bearings and races are also used to support the rising stem as lubrication of these parts is prohibited. The coolant, at a rate of 13,200,000 lb per hour, enters the reactor at 550 F and leaves at 800 F.

Reactor is designed to produce plutonium at a breeding ratio of 1.20. It will be fueled with 25.6% enriched uranium in a core 30.5 in. in diameter and 30.5 in. high. A breeder blanket of uranium surrounds the core.

For additional information on this valve, circle No. 92 on the Reader-Service Card, page 122

Gasoline Plant Cuts Valve Maintenance Costs



Crane Valves Do the Job After Others Fail

Six years ago this large gasoline plant in the Southwest, installed new gate and swing-check valves on hot water pump lines handling boiler make-up water.

Bonnet joint leaks and seat leakage developed after a short time. Maintenance costs jumped. After many attempts to stop the leakage, the bonnet joints were welded shut.

Two years ago the valves finally had to be replaced. Six-inch, 150-pound Crane steel gate and swing-check valves were installed.

Today these Crane valves continue to operate without any leakage at bonnets or seats, and without a penny spent for maintenance.

Why are the Crane valves still operating *with* 100% efficiency and *without* maintenance? *It's Crane quality*—in design, materials and workmanship—that makes the difference!

For information about Crane steel valves for all services—power and process fluids handling—see your Crane Representative, or write to the address below.

IDEAS FOR YOU—This free book gives you 32 case histories of important savings with quality valves. Ask for "Valve Performance Facts."

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For more facts circle 273 on Reader Service Card, p 122

For more data on these developments, circle key numbers on Reader-Service Card, p 122

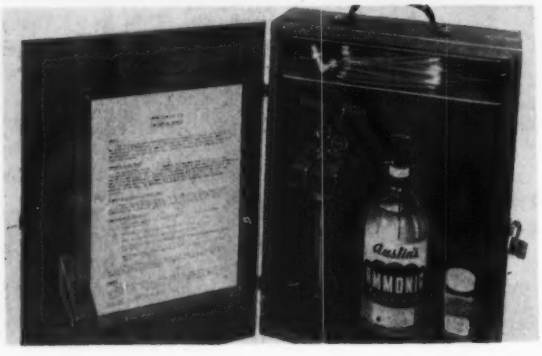
Plant equipment news... Your

Portable kit tests insulating oil fast

1 • Condition of insulating oil in electrical apparatus can be checked easily, quickly and cheaply at the installation site with this handy test kit. Periodic spot checks determine extent of sludging, indicating when a more complete laboratory evaluation is necessary.

Kit contains a box of filter paper, medicine droppers, and acidity indicator, buffer and polar-compound indicator in polyethylene bottles, plus instructions for checking the tests. The 7x9x2½-in. carrying case is made of 24-gage steel. Entire set is priced at $15.

No technical training is needed to make or evaluate tests, manufacturer states. A sample of oil is removed from transformer, breaker or regulator and dropped onto pieces of filter paper. Acidity or polar-compound indicator is added. Tester compares color and pattern with standard samples supplied in the kit and tells the condition of the oil. Standard spots are given for oil just at the verge of sludging and additional samples help estimate the actual values of acidity and polar contamination.—Allis-Chalmers Manufacturing Company



Gas detector spots transformer faults

2 • Acetylene-detector kit tells whether gas is present in any power transformer having a sealed air space above the oil level. Acetylene is one of the first products of decomposition of oil and insulation due to an arc, so its presence means that a fault has occurred.

Detector kit is a simple form of gas analyzer. Gas from the transformer is bubbled through a solution of ammonia. Formation of a brick-red precipitate in the solution indicates that acetylene is present. Equipment can sense faults which have lasted for as little as three cycles.—Westinghouse Electric Corporation

Shorter, stronger bushings now welded to transformer

3 • Welded-on low-voltage bushings of alumina bring network transformers one step closer to hermetic sealing. Bushings and magnetic liquid-level gage have eliminated the last gasketed openings in the transformer tank.

Transformer throat is lower, reducing overall height of the transformer-protector combination. Bushings are made of alumina, a ceramic boasting tensile, compressive, dielectric strength.—General Electric Company

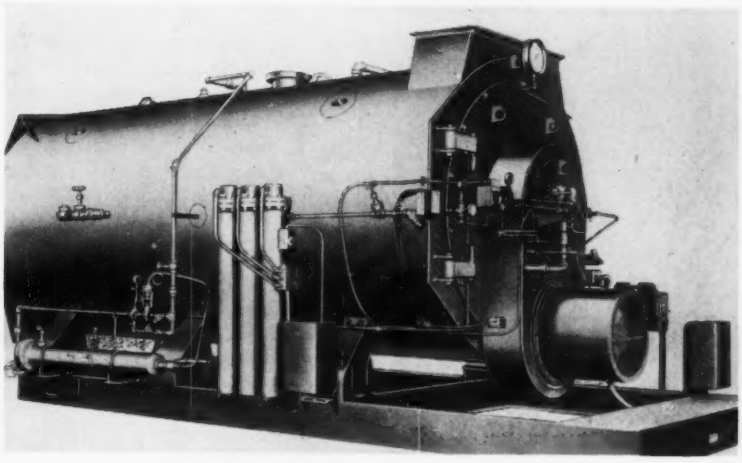
Silicon-conversion kit modernizes plating rectifiers

4 • Easily installed kit converts magnesium-copper sulfide and selenium rectifiers to silicon. Designed as a direct replacement for existing rectifier stacks, installed kit is said to reduce operating and maintenance costs and improve efficiency up to 50% since silicon has no aging characteristic and can be stored for long periods without deterioration. Each cell is hermetically sealed to keep moisture out.—Dresser Electric Co

Dc power supplies feature magnetic voltage regulation

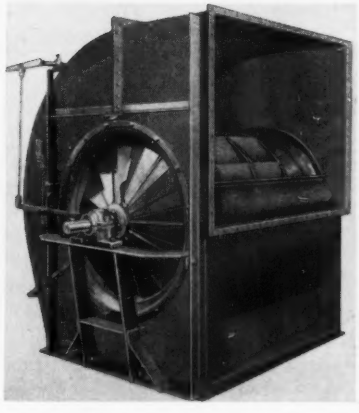
5 • Magnetic type voltage regulators, full-wave silicon diode rectifiers, capacitive input filters are components of these heavy-duty power supplies. Excellent voltage regulation is provided with a minimum of circuit complexity and units can't be damaged by output shorts, maker states. Supplies are available from stock with output voltages from 2.5 to 1000-volt dc, power capacities from 25 to 3000 watts.—Sorensen & Co, Inc

information center for new products and materials



Biggest firetube boiler delivers 26,000 lb per hr

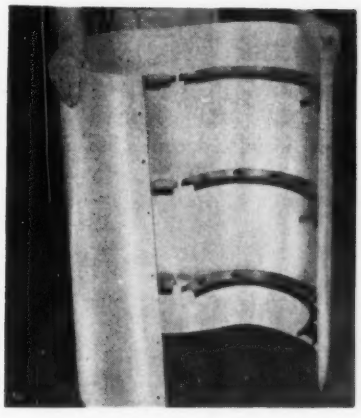
6 • Powerful new steam generator delivers 26,000 lb steam per hr at efficiencies of 80% or better down to a small fraction of rated capacity. Dimensions are 28x9½x10½ ft. Unit is designed for heavy oil or gas, but can be adapted to burn l-p gas or light oil. Generator combines advantages of packaged boilers—high efficiency, compact size, simple operation—with steaming capacities formerly associated only with field-erected boilers. —National - U.S. Radiator Corporation, Cyclotherm Div



Aerodynamic blade design is feature of heavy-duty fan

7 • Airfoil backward-curved blade design, streamlined contour of inlet permits a continuously smooth flow of air through this fan. Particularly suitable for mechanical-draft and heavy-duty work, as well as conduit type air-conditioning systems, units are designed for high efficiency, stable performance.

The 12 blades are of one-piece die-formed construction and are welded to the rim and backplate of the wheel. Internal struts to reinforce the hollow section are provided in high tip-speed classes.—Clarage Fan Company



Tough steel jacket rings simplify jacketing attachment

8 • Made in 90-deg circle segments, rings can be spot-welded around stack or other hot, noninsulated piping during or after construction. Rings hold the jacketing away from the hot surface so it remains cool. Finish doesn't burn or discolor.

Air-escape holes spaced around ring permit heat to flow upward out the stack. Each ring is 2-in. thick, formed from .032 mild steel with zinc-chromate coating. Rings can be ordered in any diameter and are available with attached jacketing.—Preformed Metal Products Company, Inc

Vinyl-coated tape seals ducts in air-conditioning systems

9 • Pressure - sensitive vinyl - coated duct-sealing tape is designed as an effective means of sealing sections of ductwork in heating, ventilating and air-conditioning systems.

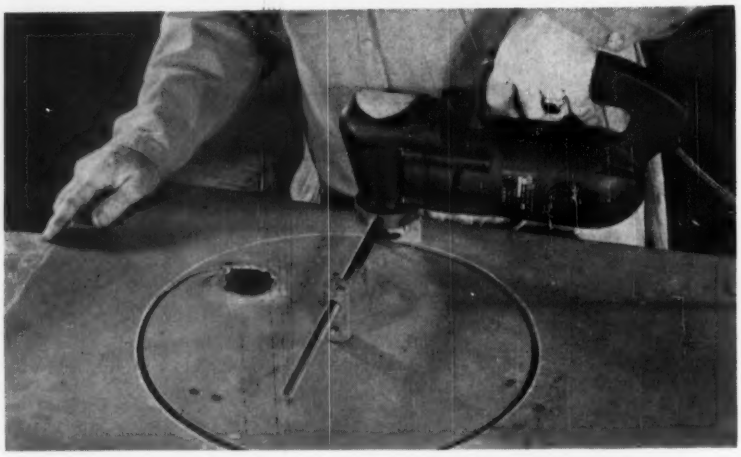
Cloth backing and special adhesive provide an effective seal against air leaks to insure permanence on the job. Tape unwinds easily for quick application, according to maker.

The sealing tape, designated *Type 676*, has excellent resistance to extreme temperature fluctuations as well as to solvents, abrasion and aging, maker states.—Permacel Tape Corp

For more data on these developments, circle key numbers on Reader-Service Card, p 122

More **equipment news**

For more data on these developments, circle key numbers on Reader-Service Card, p 122



Nibbler attachment gnaws out a perfect circle

10 • Perfect circles can be cut as small as nibbler's radius or to practically unlimited diameters with new attachment. Standard unit comes in 12- and 24-in. sizes, and extensions are available for increased radius.

Made up of machined parts, attachment costs $14.75, will fit all models of the firm's nibblers. Unit saves time and materials—a 15-in. circle in 11-gage stainless takes 4½ minutes to nibble out. Nibbler cuts up to 10-gage steel.

Circles are cut in four easy steps: (1) Mark up and make holes for nibbler, attachment. (2) Start cut free-hand. (3) Attach circle cutter. (4) Cut perfect circle, *above*. Applications for the circle cutter include maintenance work around the plant as well as use in model shops and development labs.

Attachment also has a straight-edge guide, which is useful for cutting metal at the stockpile, to save handling time and labor.—Pensco Products

Lubrication-line alarm warns of any stoppage

11 • Force-feed lubricating systems can be safeguarded against interruption with this handy protector. Installation is simple: line is cut at each terminal point and fittings connected. Then unit is hooked up electrically to a bell, whistle, control-board light or a relay to shut off motor or ring a telephone to alert plant operator.

Standard unit can be used with oil at any viscosity or synthetic lube at pressures to 10,000 psi. Explosion-proof models are available.

Low-cost "Lube-line alert" can be used on all central lubricating systems and with any make of lubricator, according to manufacturer.—Houdaille Industries, Inc, Manzel Div

Improved solid-film lube works in grease and oil

12 • Increased wear life of moving parts operating in oil or grease is predicted with use of new solid-film lube. New lube, *No. 4856*, contains small particles of lead, tin and graphite, known for good bearing properties. Material is semiporous, so it absorbs oil, acts as a reservoir against metal-to-metal contact under high loads or during long shutdown periods. It is compatible with additives in oils and greases.

First developed for use on titanium under heavy loads, lube is applicable to spherical bearings, clutch assemblies, leather oil seals, sleeve bearings, valve stems, piston cylinders, hydraulic actuator parts.—Electrofilm, Inc

Bearing lubricator signals for refill

13 • Low-cost automatic bearing lubricator holds a reservoir of lube, injects grease only as needed. Position of unit's pressure cup shows at a glance the exact amount of grease left in the reservoir.

Units are 2¼ in. long, 1⅛ in. dia. They are installed one per bearing—fitting is removed and lubricator screwed into place. They operate in any position, can be mounted in cramped quarters with adapter fittings, are filled with standard grease gun.

Combination of bearing vacuum and lubricator spring pressure discharges enough grease to replace amount used, eliminates bearing burnout and over- or under-lubrication. Units cost $18.25 a dozen. —Anchor Chemical Co

Oiler, cleaner combo services chain on the job

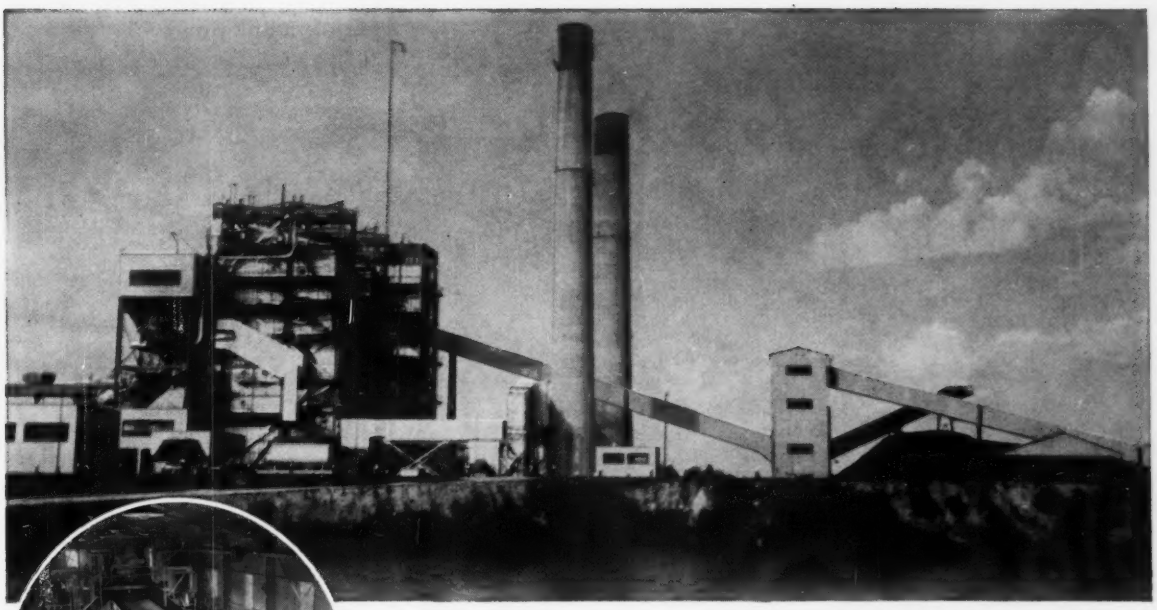
14 • A lubricating brush and cleaning brush team up to keep chains in good condition. Stainless-steel shank brush cleans chain automatically while in operation. It precedes the lubricating brush, wipes chain clean of foreign matter picked up in dirty or dusty surroundings, as well as abrasive contaminated lube.

New brush line features a mechanical bond on the bristles that gives a secure attachment, preventing bristles from coming loose, improving wearing qualities and increasing variety of applications.

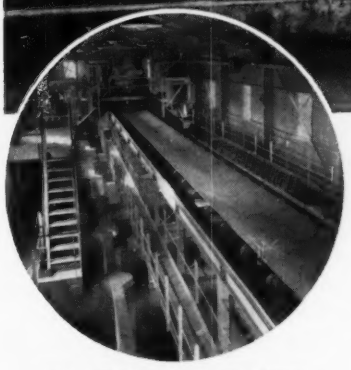
Bristle materials available are horsehair for normal lubricating applications, nylon for high-speed chains where greater wear resistance is needed and stainless steel for high-temperature lubrication and chain cleaning. Sizes are ⅝, 1 and 1½ in. dia, and ⅜x2¼ in. Cleaning attachments are available for all types of chains.—Oil-Rite Corporation

continued

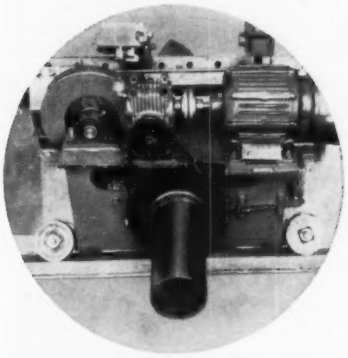
For more data on these developments, circle key numbers on Reader-Service Card, p 122



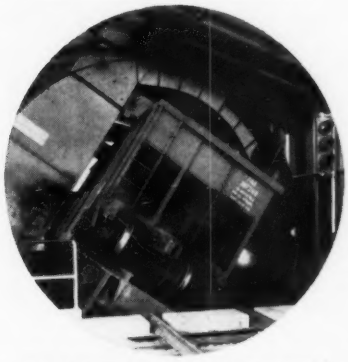
H & P Built the Complete Coal Handling System for Carolina Power & Light Company's Lumberton Station. Engineers & Constructors: Ebasco Services Incorporated.



H & P Coal Conveyor and Tripper



Reciprocating Thorsten Coal Sampler



H & P Rotary Railroad Car Dumper with Integral Electronic Scale (Pat. Pend.)

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For more facts circle 274 on Reader Service Card, p 122

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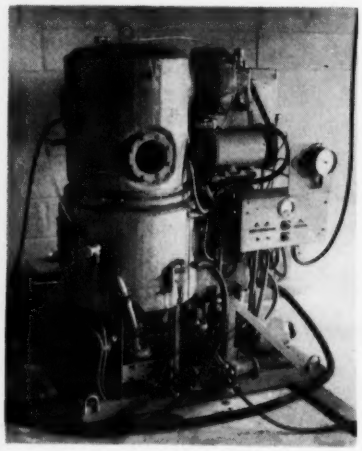
Equipment news

Begins on page 134

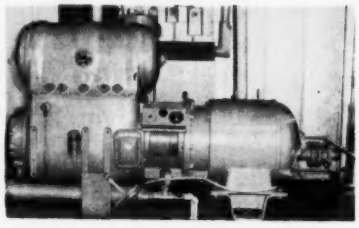


Seawater distilling machine

15 • Inexpensive fresh water from the sea is produced by new machine. Scaling problem has been eliminated, without any acid feed; efficiency is increased because less fuel is needed. Mechanical simplicity and low corrosion rates due to low-temperature operation are added features, manufacturer states.

Unit is available in sizes from 500 to 100,000 gpd. The 500-gpd size is shown, above.—Mechanical Equipment Company

Just circle key numbers on the Reader-Service Card, page 122, to get complete product story



Improved compressor blades

16 • Made of special solid, lightweight material, rotary air compressor's new blades feature improved wear resistance. Low weight and minimum friction reduce hp requirements. New line includes compressors with displacements of 8 to 650 cfm, in 2- to 125-hp sizes, pressures to 125 psig.—Davey Compressor Co

Positioning switch

17 • Unit eliminates lags between switch and actuator mechanism for faster, more reliable remote control

IN SRE... Zallea expansion joints absorb thermal expansion of reactor core tank and outer tank

The very nature of the Sodium Reactor Experiment, conducted by Atomics International for the AEC, and the method of handling the liquid sodium reactor coolant demand reliability in expansion joints. Because of the operation there can be no compromise in design or quality.

The high temperature SRE uses Zallea Expansion Joints where thermal expansion must be absorbed and where a gas seal must be maintained. An 11-ft. diameter Zallea Expansion Joint at the top of the outer tank absorbs the expansion that results from the temperature increase in these components as the reactor comes up to operating temperature, 960°F. In addition, the expansion joints form a seal for the helium gas and sodium vapor above the sodium pool at the top of the reactor as well as for the helium gas within the outer tank.

In the sodium coolant piping circuit gas seals are effected by means of Zallea Expansion Joints in the region where the pipes leave the reactor cavity and enter the pipe galleries.

Zallea has worked with almost every major engineering and manufacturing firm engaged in atomic, nuclear and missile work—and has provided the large majority of expansion joints for such projects. As a result, we have accumulated a store of expansion joint engineering data and manufacturing skills that cannot be equalled. Whenever expansion is involved in piping systems, reactors, tanks—whatever the application—let our engineers work with you. We already have the answer to many of the difficulties you will encounter. And we welcome the chance of tackling your problem.

Zallea
expansion joints

ZALLEA BROTHERS, Wilmington 99, Del. • World's largest manufacturer of expansion joints

For more facts circle 276 on Reader Service Card, p 122

Eliminate Boiler Feedwater Problems with DEADY

DEADY Products, Recommendations and Service

There's only one way to keep your boiler feedwater operation efficient. That's by preventing and/or correcting water problems by thorough analysis and investigation of the "problem". Deady Chemical Company has been a specialist in individualized treatment of water problems since 1905.

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Under this plan, Deady Service Engineers survey your particular needs at *no cost* to you. As part of their survey, they will make a complete laboratory analysis of your water supply. After thorough study, the "custom-made" Deady Recommendations to solve your water conditioning problem will be presented to you without obligation. Periodic Deady *Service* "Check-ups" make sure your water is properly treated.

Your small investment in Deady products will be repaid many times over in the plant protection you'll receive. Why not write for the illustrated folder describing the Deady Plan in detail? No obligation, of course.

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San Francisco, Calif.
Seattle, Wash.
Pittsburgh, Pa.
Memphis, Tenn.
Chattanooga, Tenn.
Charlotte, N. C.

Equipment news

Begins on page 134

of pneumatically operated industrial processes. Switch is 20% smaller than earlier models. Turning the knob gradually increases or decreases flow of compressed air to pneumatic valves or damper motors. Hysteresis is eliminated through use of a responsive ball valve, maker states. — The Powers Regulator Company

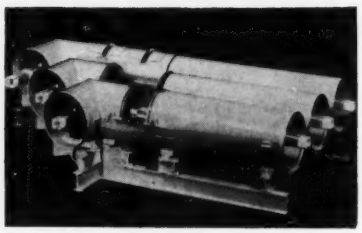
V-belt drives

18 • New line of V-belt drives features smaller and lighter sheaves and V-belts of higher capacity at lower cost.

Drives are offered in two standard groove sizes, 3/8- and 5/8-in. width, to handle drives up to 200 hp. There is a series of made-to-order sheaves and 1-in. belts for up to 1500 hp.

New belts have a crowned top and concave sidewalls for greatest efficiency. They are oil and heat resistant and static conducting.—Dodge Manufacturing Corporation

Just circle key numbers on the Reader-Service Card, page 122, to get complete product story



Isolated phase bus

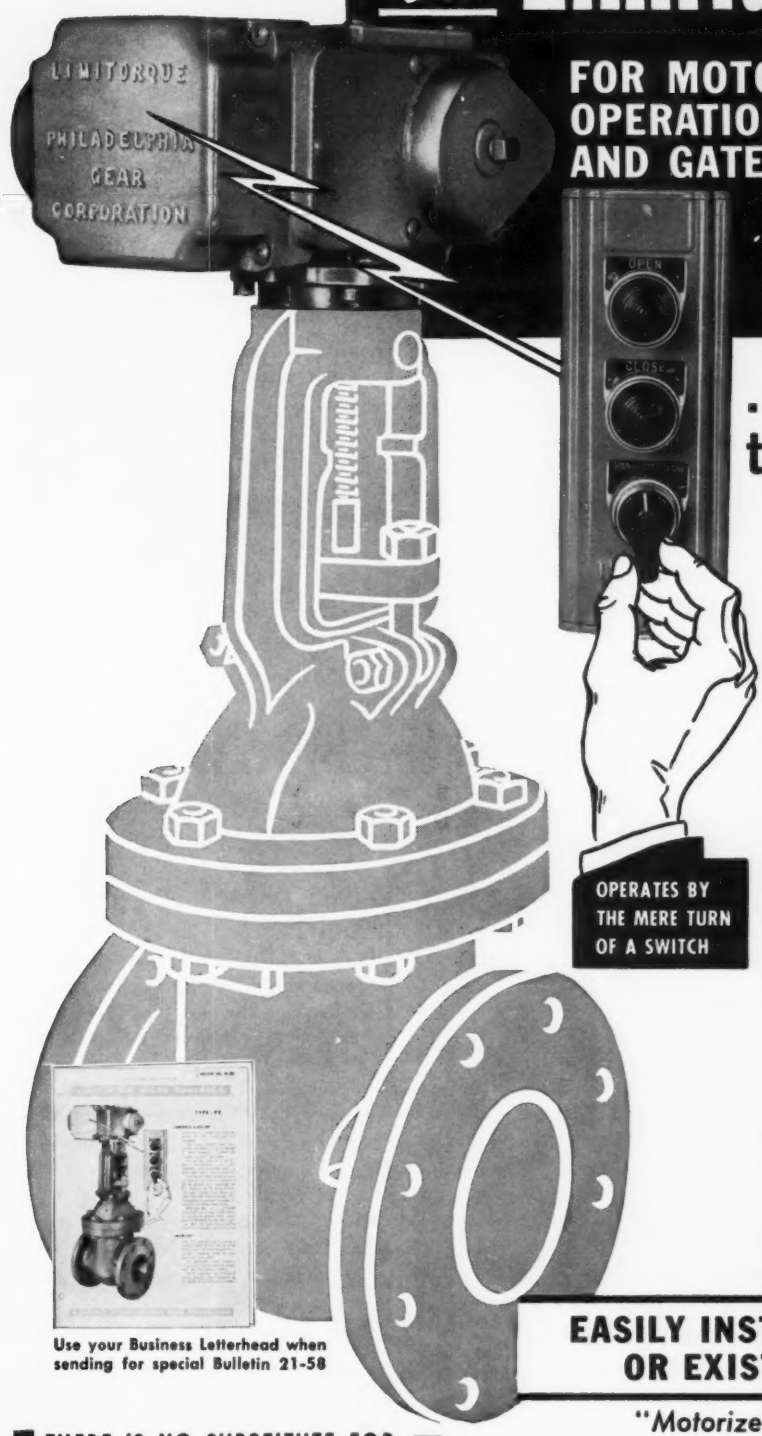
19 • Designed with round enclosures, single insulators at each conductor support station, new bus will with-

New LimiTorque

TYPE P-2

FOR MOTORIZED AUTOMATIC OPERATION OF SMALL GLOBE AND GATE VALVES

. . . Economically and Efficiently



. . . truly a dependable time and money saver

Here is a new, compact, economical and dependable LimiTorque Motorized Operator for use on small (normally hand-operated) Globe and Gate Valves — either new or already in service. Your existing hand-operated valves can now be easily motorized by the removal of the hand-wheel, and mounting the P-2 Unit on the same bonnet . . . the Unit output drive sleeve will then drive the hand-wheel unit, which arrangement is suitable for both rising and non-rising stem valves.

The P-2 LimiTorque Operator has a standard out-put speed of 22.5 or 45 rpm, which covers the average and recommended operating speed for most Globe and Gate Valves.

Remember, this new P-2 LimiTorque is built by the largest manufacturer of Motor Operators for Valves in the World . . . backed by nearly 30 years experience.

BE CONVINCED how the P-2 can save you time, labor and money in the operation of small valves — just write for Bulletin No. 21-58, which not only illustrates and explains its operation, but shows how easily it can be installed on existing or new valves.

Contact your Valve Manufacturer, or your nearest LimiTorque Sales Engineering Office.

Use your Business Letterhead when sending for special Bulletin 21-58

EASILY INSTALLED ON NEW OR EXISTING VALVES

"Motorize to Economize"

THERE IS NO SUBSTITUTE FOR —

LimiTorque®

PHILADELPHIA GEAR CORPORATION

ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia

For more facts circle 278 on Reader Service Card, p 122

MOST MAJOR U.S. POWER PRODUCERS REDUCE COSTS with PANALARM ANNUNCIATORS

MAXIMUM INFORMATION on all process variables . . . the result of 10 years system engineering by Panalarm and major power producers. That's why Universal Series 50 is the power industry's most informative annunciator. Trouble anywhere is signalled instantly—*before* it can grow big and expensive. "Off-normals" are pinpointed instantly, accurately for fast remedial action, reducing costly "outage" losses.

Economical, highly flexible design facilitates system expansion. Can be simply adapted to your exact requirement, avoiding costly custom designing. Proven components—e. g., almost 1,000,000 dependable Panalarm developed relays have been used in Panalarm Annunciators.

Ask your nearby Panalarm sales engineer to show you why Universal Series 50 is the power industry's No. 1 annunciator choice . . . how its adaptability and reliability can help increase your profits . . . by producing maximum information and reducing costly "outages." No obligation, of course.

Write for Catalog 100 B today.

PANALARM®

Division of

PANELLIT, INC.

7401 No. Hamlin Ave., Skokie, Ill.

For more facts circle 279 on Reader Service Card, p 122

ENCO BURNERS

FOR

OIL, GAS OR TAR

Steam or mechanical atomizing...1 to 1000 gallons per hour

Designed for operation with either gas, oil or both with natural or forced draft. They can be depended on for maximum combustion efficiency.

ENCO Interchangeable Oil-Burners can be changed instantly to operate by either steam or mechanical pressure atomizing over a wide capacity range.

ENCO Oil Atomizers are applied to various types of standard pulverized-coal and gas-burner units cold starting or for full load operation when coal or gas is not available, or when oil is the more economical fuel.

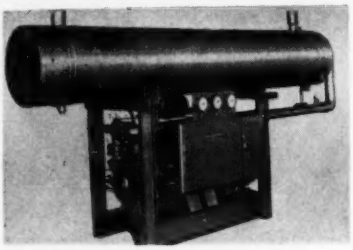
Send for Bulletin OB-53 describing ENCO Gas and Oil Burners, also complete Pumping and Heating Units.

EC 509

THE ENGINEER COMPANY, 75 West Street, New York 6, N. Y.

stand higher internal pressure than conventional square enclosures.

Unit is made of a cylinder rolled from a single sheet of aluminum. It needs no pressure relief. Sealer type and closed-cell neoprene sponge-rubber gaskets are used to keep out moisture. Units come in ratings of 14.4, 23 and 34.5 kv, with current ratings of 1200 through 20,000 amp.—General Electric Company



Packaged water chillers

19 • Redesigned line of packaged chillers is for air-conditioning or industrial-cooling applications. Chillers are available in nine sizes from 20 to 125 hp. New feature is capacity control, actuated by crankcase suction pressure.—American Standard, American Blower Div

Vertical motors

20 • NEMA Type II weather-protected motors are for use in heavy-duty industrial applications. The line is designed for year-round use where continuous operation under severe weather conditions is necessary.

Motors feature direct blow-through passages, permitting high-velocity air to pass through motor without entering the active parts. A series of low-velocity air lifts combined with labyrinth turns and baffles precipitates moisture or other contaminants before the air reaches electrical parts. General Electric Company

Just circle key numbers on the Reader-Service Card, page 122, to get complete product story

Tungsten-carbide hard facing

21 • New spray-powder material permits hard facing with sprayed tungsten carbide at better than 90% deposit efficiency. Coating speeds are 110 to 150 sq ft per hr, for a coating .001 in. thick.

Coatings are torch fused after

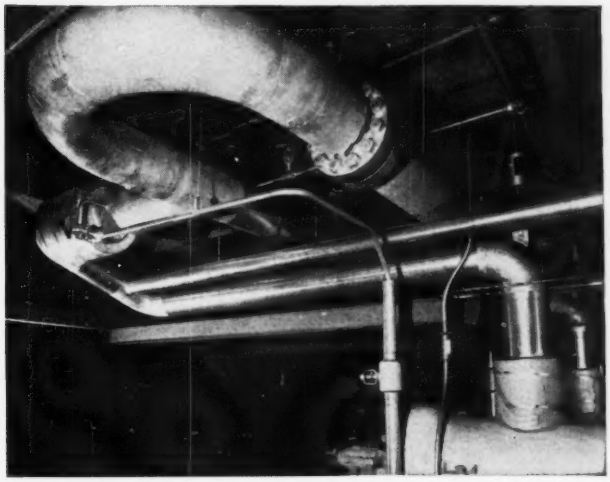
For more facts circle 280 on Reader Service Card, p 122

circle 281 on Reader Service Card, p 122 ➤

25 YEARS* OF SATISFACTION with MIDWEST PIPING

That is the experience of THE HAWAIIAN ELECTRIC COMPANY

Of the eight piping contracts the Hawaiian Electric Company placed with Midwest during the past quarter century, two were for the L. A. Hicks Plant shown above.



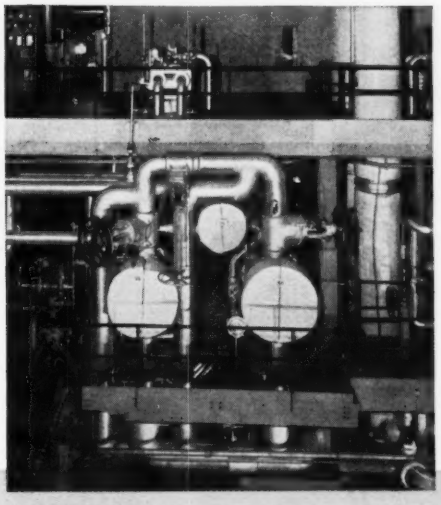
Boiler feed piping fabricated and installed by Midwest for the last unit in the L. A. Hicks Plant in Honolulu.

Benefits that Hawaiian Electric and many other electric utilities get by using Midwest Piping include:

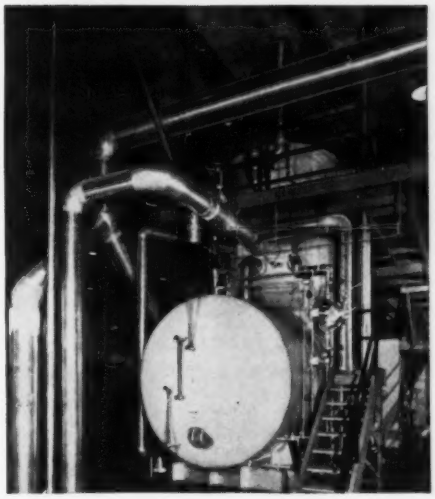
- Unequalled experience of Midwest fabrication and construction organizations.
- Erection planning by staff engineers before fabrication.
- Accurately fabricated subassemblies that simplify and expedite field erection.
- Convenient locations of three fabricating plants.
- Continuous piping research and development.

This adds up to a better piping job . . . on time and at minimum cost. It will pay you to call in Midwest the next time you need piping.

8 CONTRACTS SINCE 1933



(Left) Showing Midwest Piping for horizontal and vertical feed water heaters for last two units at L. A. Hicks Plant.



(Right) Main steam and deaerator piping for last unit. Design conditions are 1500 psi and 950°F.

8093

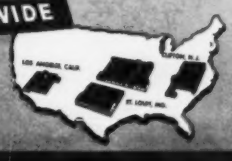
MIDWEST PIPING COMPANY, INC.

Main Office: St. Louis 3, Mo. (P. O. Box 433)

PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

SALES OFFICES: Asheville (Box 446, Skyland, N.C.) • Atlanta 9—72 11th Street, Northeast • Boston 27—426 First Street Chicago 3—79 West Monroe St. • Cleveland 14—616 St. Clair • Houston 2—1213 Capitol • Los Angeles 33—520 Anderson Miami 34—2103 Le Jeune • New York 7—50 Church St. • Pittsburgh 19, Pa.—437 Grant • San Francisco 11—420 Market St. St. Louis 4, Mo.—1450 South Second St. • Tulsa—1640 East 21st St.

MIDWEST PIPING SERVICE IS NATIONWIDE

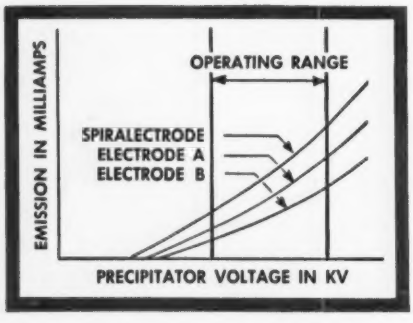


1500 miles of Spiralectrodes in Precipitator Service!

That's real proof of superior performance. Over 1500 miles of these emitting electrodes have been installed in 'SF' electric precipitators . . . delivering 50 to 100% more electron emission than conventional types of electrodes.

There are sound reasons why Buell *Spiralectrodes* are providing superior emitting efficiency in actual dust collecting applications.

- *Spiralectrodes* are *"emission engineered"* – pitch and diameter are custom designed for each application . . . of critical importance with high resistivity dust.
- *Spiralectrodes are precision made from stainless steel*– of uniform quality, corrosion-resistant.
- *Spiralectrodes minimize efficiency-loss of dust build-up* –no horizontal surface to collect dust, positive rapping cleans electrodes.
- *Spiralectrodes maintain predetermined tension* – (no weights required) . . . dampen effect of vibration caused by electrical pulsation, thereby minimizing electrode breakage.
- *Spiralectrodes'* controlled area emission stops sparking effect of "point emission."



Above chart illustrates the superior emission of the Spiralectrode: its corona voltage is lower and its emission is higher than other types of emitting electrodes over the entire operating range of industrial precipitator voltage.

The superior operating characteristics of Spiralectrodes contribute to continued high efficiency of Buell 'SF' Precipitators. Detailed information of this and other exclusive features are described in a booklet, "Buell 'SF' Electric Precipitators." Send for your copy: write Dept. **50-C, Buell** Engineering Company, Inc., 123 William Street, New York 38, New York.

buell®

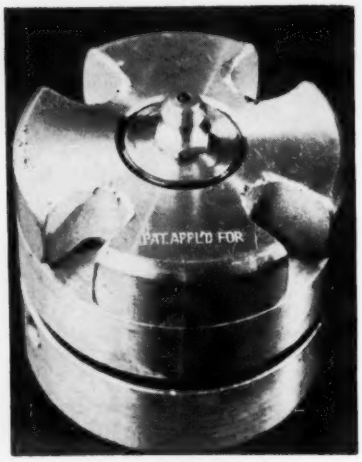
Experts at delivering Extra Efficiency in

DUST COLLECTION SYSTEMS

Equipment news

Begins on page 134

spraying, and close control of coating thickness plus smooth surface produced minimize finishing operations. The process should find wide application on parts subject to extreme wear conditions.—Metallizing Engineering Co, Inc

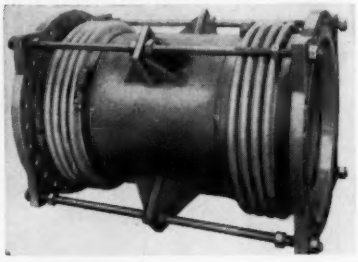


Ball-bearing greaser

22 • Greasing tool was developed for frictionless, sealed ball bearings. Unit is a hollow shaft on a circular base. Bearing is slipped down into position with a nut, and a hand grease gun is applied to fitting on top of shaft to force grease down into shaft, into a tube in the base and out, under pressure, into the bearing.

Two models are available. Model *A* is for bearings with ID's from 0.750 to 1.0625 in., OD's from 1¼ to 2 in. Model *B* is for bearings with ID's from .375 to .687 in., OD's from ¾ to 1⅝ in.—P-G Corporation

Just circle key numbers on the Reader-Service Card, page 122, to get complete product story

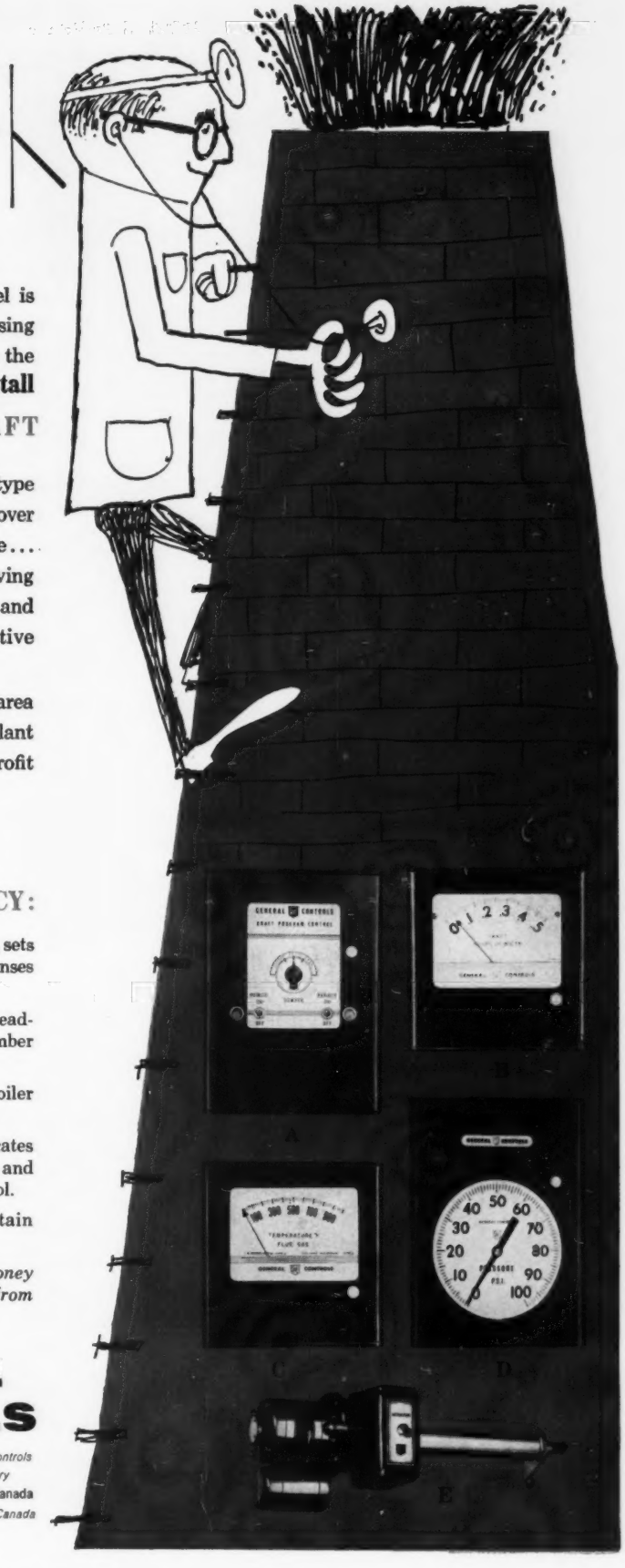


Universal expansion joints

23 • Bellows type units accommodate pipe movement in any direction. Joints are packless, corrugated. They protect power and process piping by

"My advice:

QUIT SMOKING!"



Smoking costs too much. It's a sure sign fuel is being wasted... that burner and boiler are losing efficiency... that profits are going up with the smoke. But you *can* do something about it! **Install a GENERAL CONTROLS DRAFT CONTROL SYSTEM.**

Goes in easily and inexpensively with any type boiler...any type fuel. Pays for itself over and over again through the years by cutting fuel waste.... saves as much as 25% on fuel cost as well as saving on manpower. Not least, think of the plant and city-area good will you'll create with effective smoke control.

Call in the GENERAL CONTROLS MAN in your area to check out a draft control system for your plant now. The sooner, the better your long-range profit picture will look.

HOW TO IMPROVE YOUR BOILER EFFICIENCY:

A DRAFT PROGRAM CONTROL: start-up, shut-down, sets damper for any firing rate. Fast, accurate...senses atmospheric changes.

B DRAFT INDICATOR: provides continuous visual readings of draft conditions in combustion chamber and/or stack.

C FLUE GAS TEMPERATURE INDICATOR: shows boiler efficiency by indicating excessive heat loss.

D STEAM PRESSURE INDICATING CONTROLLER: indicates boiler pressure on main instrument panel, and gives accurate on-off, or proportioning control.

E ACTUATOR: operates stack damper to maintain constant combustion chamber draft.

A draft control system like this is worth money in the bank to you. Get the full facts today from

GENERAL CONTROLS

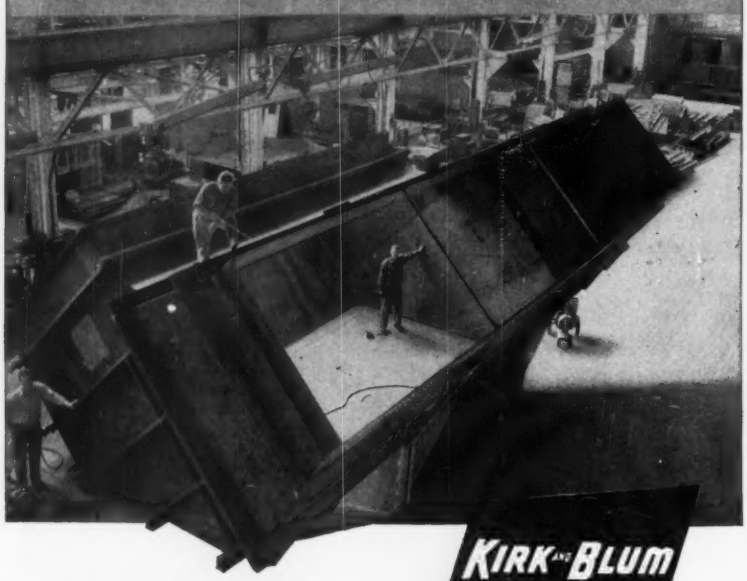
Manufacturers of America's Finest Automatic Controls for Home, Industry and the Military

Glendale, Calif. • Skokie, Ill. • Guelph, Ontario, Canada

Six Plants—42 factory branch offices serving the United States and Canada

BREECHINGS · STACKS

AIR AND GAS DUCTS



KIRK AND BLUM

PLATE FABRICATION
FOR POWER PLANTS

Whatever your requirements in fabricated plate, sheet or structurals for power plant use . . . call on experts!

Kirk & Blum has fabricated a variety of power plant needs as big as the mammoth breeching section shown here. In a 150,000 sq. ft. plant, with crane capacity to 25 tons, Kirk & Blum has complete facilities to produce, pre-assemble and load the largest fabrication. Kirk & Blum has the men, materials and experience to do the job quickly and economically.

For detailed literature, write: The Kirk & Blum Mfg. Co. 3233 Forrer St., Cincinnati 9, Ohio

KIRK & BLUM
FABRICATION

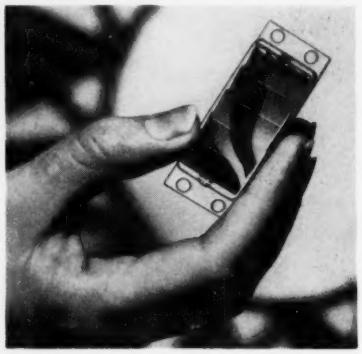
Equipment news

Begins on page 134

absorbing axial movement, lateral deflection and angular rotation, singly or in any combination.

Basic elements are two hydraulically formed bellows, a center section of pipe and appropriate tie rods. Units come in standard sizes from 3 to 72 in. dia, pressures to 2500 psi and temperatures from –320 to 1600 F.—Zallea Brothers

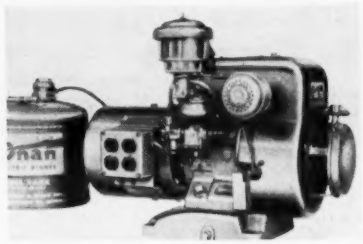
Just circle key numbers on the Reader-Service Card, page 122, to get complete product story



Silicon solar cell modules

24 • High-efficiency converter modules will supply 100 w of power from 14 sq ft of cell area. "Building block" units can convert up to 8% of the radiant energy falling on their surfaces, maker states.

Modules are assemblies of series- and parallel-connected silicon solar cells with ruggedized contact strips. Each module has five series-connected 1x2-cm solar cells embedded in an epoxy mold.—International Rectifier Corporation

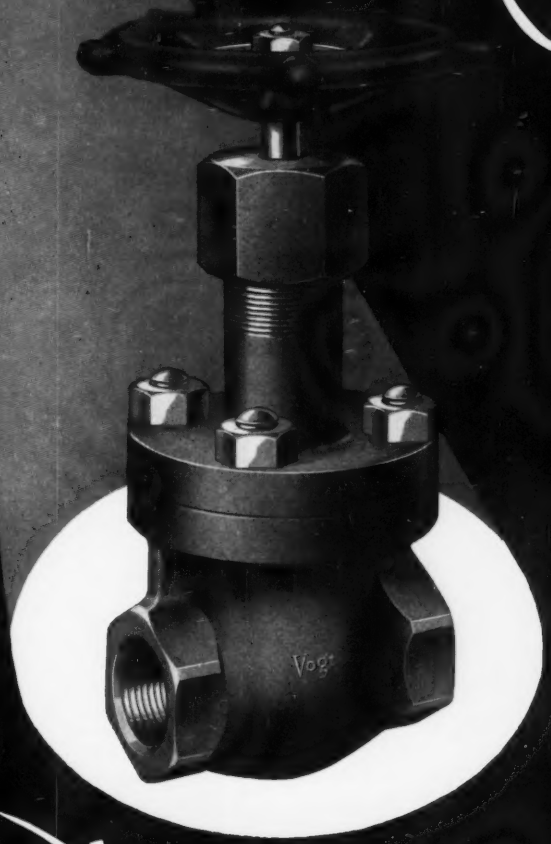


Dual-role electric generator

25 • Lightweight 2500-watt electric generating plant is used as a heavy-duty portable power unit or for standby service. Self-contained plant comes with a separate 5-gal fuel tank. It delivers 115, 230 or 115/230-volt current.—D W Onan & Sons Inc

continued

Spotlighting 2 NEW VOGT VALVES



★

FORGED STEEL

INSIDE SCREW

Bolted Bonnet

GENERAL GP PURPOSE

GATE and GLOBE

VALVES

150-800 Pounds Service

2000 Pounds Cold, W.O.G.

Available from stock in
¼" thru 2" sizes and in both
socket weld and screw ends.

CHECK THESE FEATURES

1. Forged steel pressure containing parts designed for light weight and brute strength.
2. Hard faced seats and hardened discs and wedges.
3. Spiral wound stainless steel or Monel gaskets to suit trim.
4. Extra deep stuffing box for long packing life.
5. Dished sure-grip handwheel.

Write for literature Dept. 24A-FP

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

SALES OFFICES

New York, Chicago, Cleveland, Dallas, Camden, N.J., St. Louis, Charleston, W.Va., Cincinnati

Vogt

GENERAL GP PURPOSE

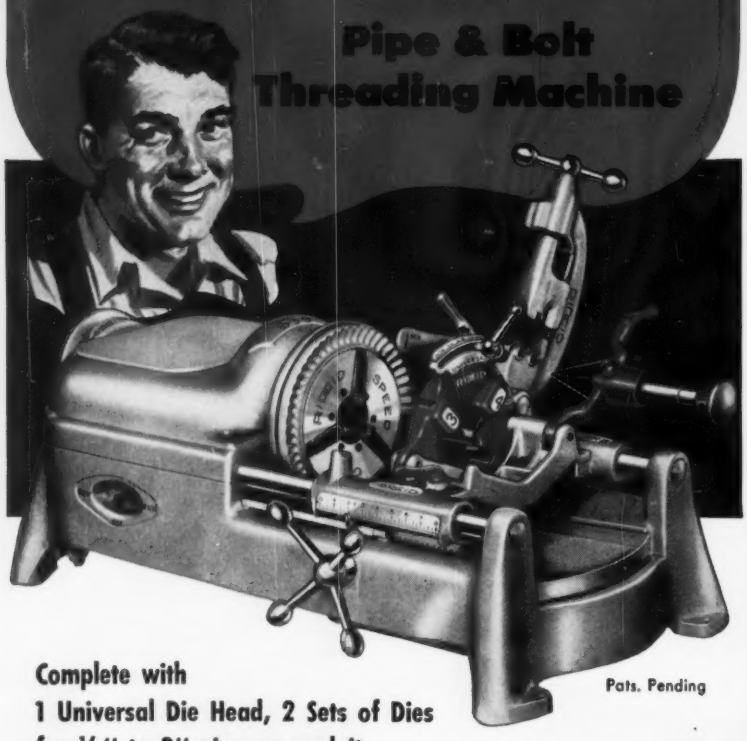
Vogt FOR BETTER VALVES & FITTINGS

FORGED STEEL

VALVES

For more facts circle 285 on Reader Service Card, p 122

Checked 'em all . . . got
Far More for My Money
when I bought this terrific new
RIDGID® 535
Pipe & Bolt
Threading Machine



Pats. Pending

Complete with
1 Universal Die Head, 2 Sets of Dies
for ½" to 2" pipe or conduit

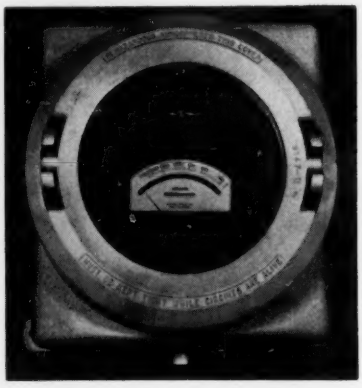
Looks good, does better. Perfect cutting, reaming, threading fast . . . and easy! Three tools operate independently . . . swing up out of the way for short pipe chucking from front. Slip-proof Speed Chuck is a great performer. Concealed oil system, automatic shut-off nozzle. Quick-opening die head sets to size right in machine. Power? . . . RIDGID-built motor handles 2" pipe, conduit, bolt, rod —and 12" geared tools easily. Try it, compare it . . . and you'll understand its enormous popularity! Leg and wheel stands available. At your Supply House.

Time-savings on just 3 large jobs more than paid the $460.00 price!

The Ridge Tool Company Elyria, Ohio, U.S.A.

THREADED PIPE . . . It's Tight . . . It's Best . . . Costs Less!

Equipment news



Electrical gas flowmeter

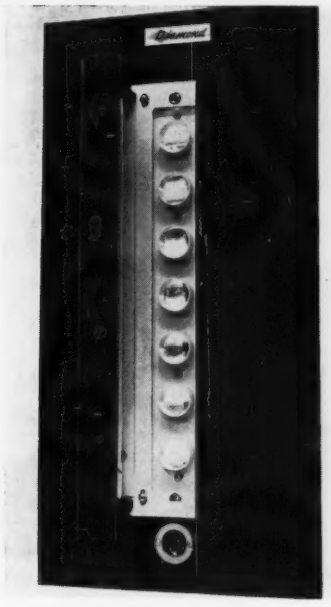
26 • Underwriters' Laboratory-approved unit is calibrated for true mass flow, for use with some flammable and explosive mixtures. Development of this safe electrical flowmeter makes possible remote indication of mass flow in gas lines.

Unit is extremely sensitive, can detect small leaks to increase overall system safety. It measures total quantity directly. Unit is operated from 110-volt 60-cycle ac, and circuit includes a voltage-regulating transformer to eliminate effects from line voltage variations. *Model F1-6* costs $395.—Hastings-Raydist, Inc

Gas analyzer

27 • Concentration of one gas in a multicomponent mixture can be measured with this instrument. It uses the thermal conductivity principle of measurement, and takes into account differences in convective heat losses from hot filaments. Unit can be calibrated for any gas in narrow (0-1%) or wide (0-100%) concentration ranges. Applications include measurement of CO_2 in flue gas, process control or combustion control.—Mine Safety Appliances Company.

Begins on page 134



Television accessory

28 • Magnifier is designed for use with closed-circuit TV for remote reading of boiler-drum water-level gages. It comes prewired, with lamps installed ready to mount. Unit magnifies four times, weighs 2 lb, needs only a screwdriver and end wrench for installation. It costs $187.50. —Diamond Power Specialty Corp, Electronics Div

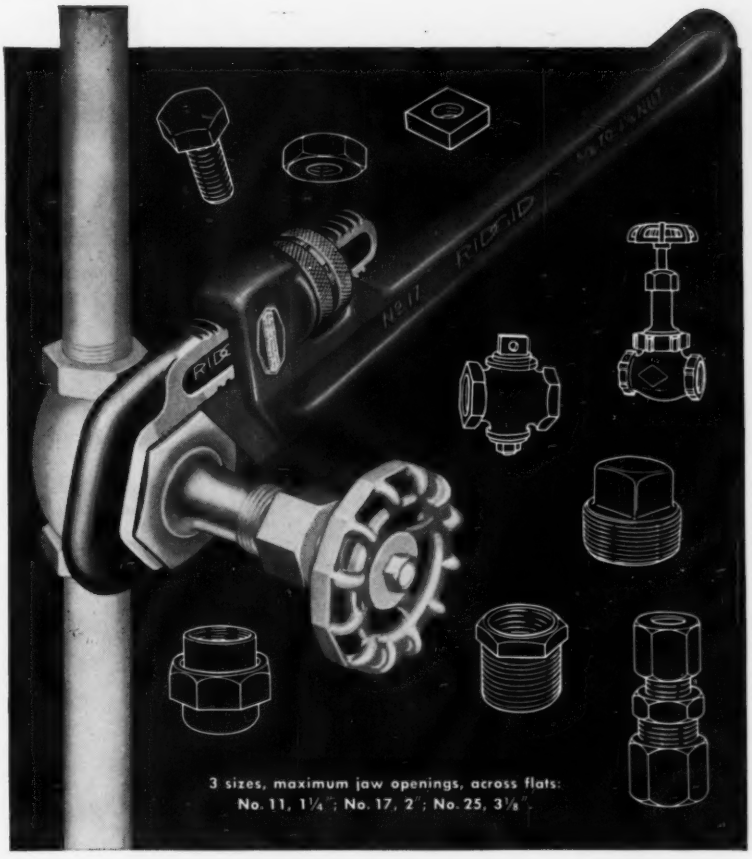
Flexible medium computer

29 • Transistorized system can do data-processing and scientific computation simultaneously. With parallel processing, the central processor can perform up to eight separate jobs at the same time.

Built-in traffic control enables computer to communicate simultaneously with eight input and output devices, such as punch-card readers, printers or magnetic-tape units. This eliminates bottlenecks caused by slower supporting equipment and provides flexibility for the system.

Multiprogram control lets *Model 800* divide itself into as many separate computers as there are jobs to be run simultaneously. Monthly rental starts at $11,000. —Minneapolis-Honeywell Regulator Co

Just circle key numbers on the Reader-Service Card, page 122, to get complete product story



Master of Every Nut and Bolt...

NEW RIDGID®

Hex Wrench

Wide-open fast-action multi-sided grip on every hex, square and flathead!

"Got the RIDGID name on it? . . . Okay, I'll take it!"

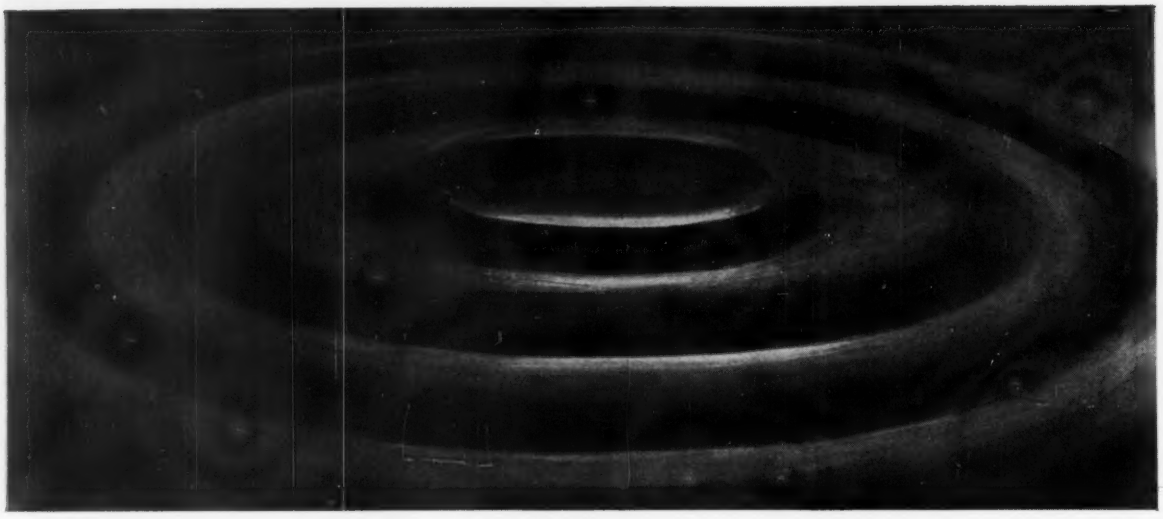
Quick adjustment—stays to size . . . this new Hex Wrench goes on easily, won't slip off—harder you pull, the tighter it grips . . . no more skinned knuckles or rounded nut shoulders! Narrow jaw for close quarters. Famous RIDGID heavy-duty design, guaranteed housing, comfort-grip handle. Three sizes for ⅜" to 2" nuts. Make your work easier and faster — buy new RIDGID Hex Wrenches at your Supply House!

The Ridge Tool Company Elyria, Ohio, U.S.A.

THREADED PIPE . . . *It's Tight . . . It's Best . . . Costs Less!*

For more facts circle 287 on Reader Service Card, p 122

Griscom-Russell Evaporator Purities



Tests, recently conducted on a Griscom-Russell Bentube Evaporator in service at a large eastern utility, have shown that the G-R evaporator design consistently provides less than the guaranteed 1 ppm—as low as .005 ppm.

For full particulars on this test—the purities obtained, the importance of liquid levels and separators, and varying turbine loads, plus other useful information, contact your local G-R Representative.

This, and all the other information we have learned in our 90-plus years of engineering and manufacturing of heat exchange equipment, is yours, both as a service and as the basis for the design and construction of better evaporators, feedwater heaters, oil and air preheaters and coolers, and other heat transfer equipment for the power industry.

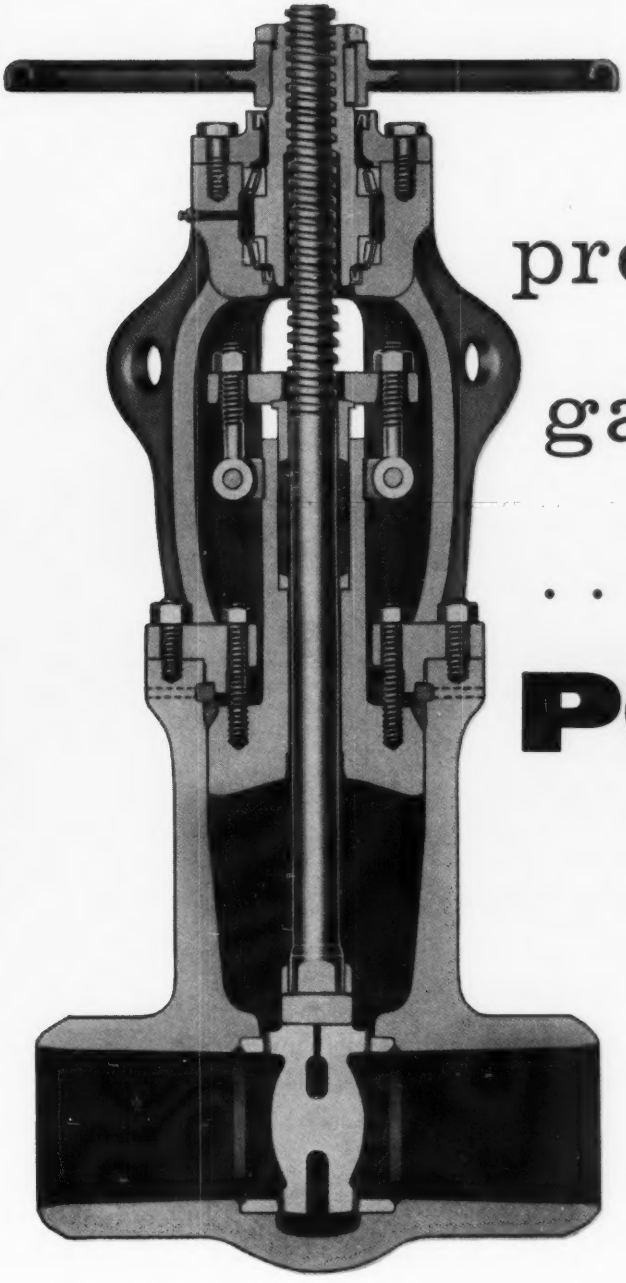
Specialists in the Engineering and Construction of Heat Exchange Equipment

feedwater heaters, evaporators, condensers, oil heaters, air, gas, and liquid heat exchangers—finned and bare tube, tank heaters, air-cooled fin-fan exchangers, sea water distilling plants, helically and longitudinally finned tubing, and many other products.

Griscom-Russell — A GENERAL PRECISION COMPANY

THE GRISCOM-RUSSELL COMPANY
MASSILLON, OHIO
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION
GR 401

For more facts circle 288 on Reader Service Card, p 122



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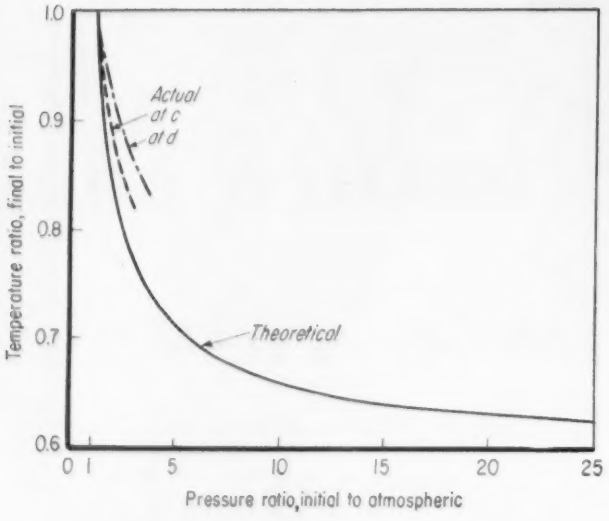

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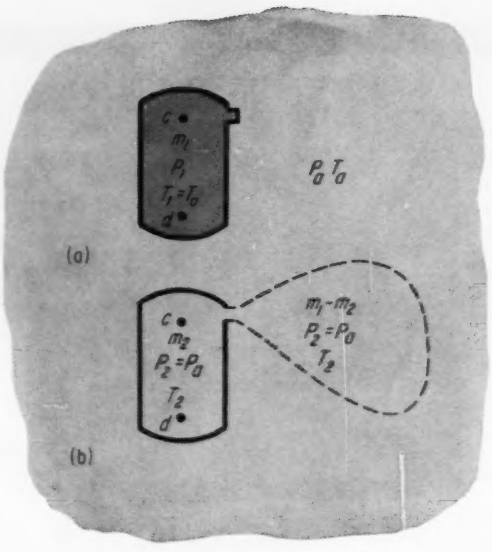

(b)

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Blowdown cooling. In Fig. 1*b* we have a tank of compressed air with a mass m_1 at a temperature $T_1 = T_a$ (temperature of atmosphere) and pressure P_1. The atmosphere surrounds the tank with pressure P_a.

When we open the valve the tank air blows out at considerable speed. If m_2 lb air stays in the tank, $(m_1 - m_2)$ lb leaves the tank and pushes back the atmosphere at constant pressure P_a. Let's concentrate on what happens to m_1.

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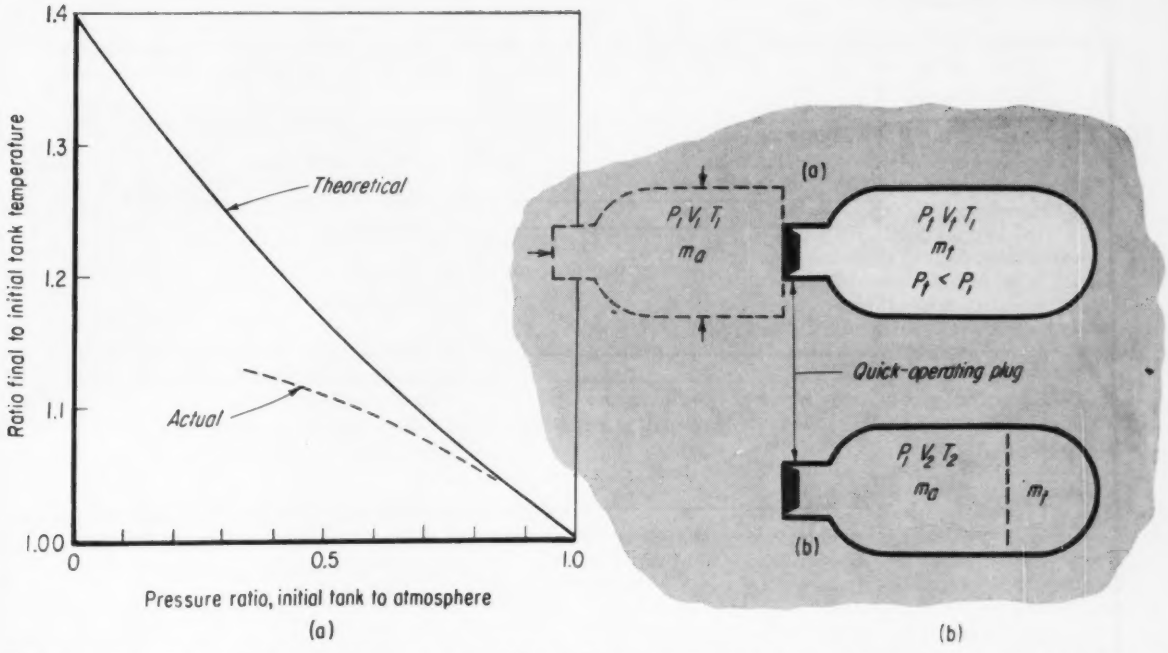
Initially all we have is the internal energy of m_1 which is m_1E_1. After the process has ended we have m_1E_2 internal energy and during the process we did flow work on the atmosphere of $(m_1 - m_2)P_aV_a/J$. From the first law we can then write:



2 Split-second opening and closing of bottle originally holding a vacuum makes the entering air trapped in bottle very hot. Thermo assumes work done on incoming air by atmosphere gives extra energy to trapped air and raises its temperature sharply

$$m_1E_1 = m_1E_2 + (m_1 - m_2)P_aV_a/J \quad (1)$$

Substituting, we get:

$$m_1c_vT_1 = m_1c_vT_2 + (m_1 - m_2)RT_a/J \quad \textbf{(2)}$$

Substituting $T_1 = T_a$ and clearing this equation we get:

$$\frac{T_2}{T_1} = 1 - \left(1 - \frac{m_2}{m_1}\right)\frac{R}{c_vJ} \quad (3)$$

With a fixed tank volume V_t cu ft, the tank pressure depends on both mass of gas in the tank and its temperature. Before expansion we have $V_1 = V_t/m_1$ and after expansion $V_2 = V_t/m_2$; then for both states:

$$P_1V_t/m_1 = RT_1 \quad (4)$$

$$P_2V_t/m_2 = RT_2 \quad (5)$$

Dividing (4) by (5) and clearing:

$$\frac{P_1}{P_2} = \frac{m_1T_1}{m_2T_2} \quad (6)$$

Substituting symbols for the pressure and temperature ratios:

$$P_r = \frac{m_1}{m_2}\frac{1}{T_r} \quad (7)$$

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$$P_r = \frac{k-1}{T_r(T_r + k - 2)} \quad (10)$$

This equation is plotted in Fig. 1*a* as the theoretical curve. Curves *c* and *d* show the temperatures actually found by experiment at point *c* near the tank discharge and at point *d* remote from the discharge. One experimenter found that the gas temperature near the tank outlet dropped as soon as the valve opened, as at *c* in Fig. 1*b*. But the air temperature remote from the outlet, as at *d*, didn't start dropping until about one minute later. The tank held about 20 cu ft.

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But molecular velocities of the tank air range from zero to over three times the root-mean-square average (Maxwell distribution). It seems that the faster molecules leave the tank first because of their higher speed. The lower average speed of the slower molecules left behind in the tank means the air remaining will have a lower temperature.

The lag in temperature drop in remote parts of the tank shows that the diffusion of the higher velocities through the mass of air takes time; the air does not act homogeneously.

The separation of molecules by speed differences can take place in transient flows such as this where there is a limited source of air or gas. In steady flow from unlimited sources of gas there is a constant distribution of slow to fast molecules, so we don't find similar temperature drops in the source as for transient flows.

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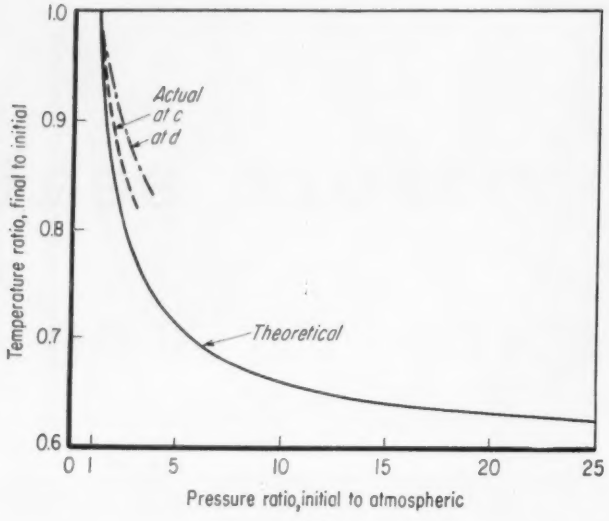

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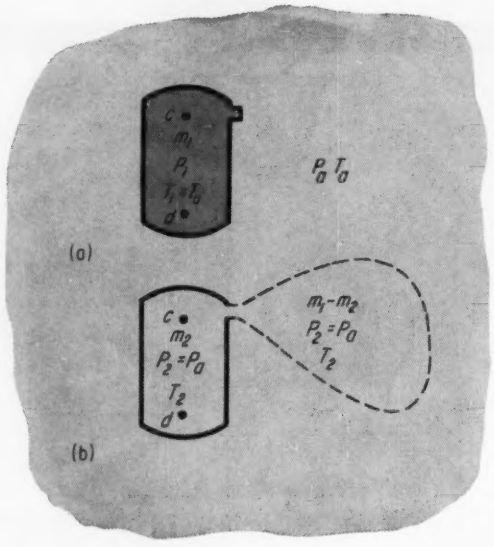

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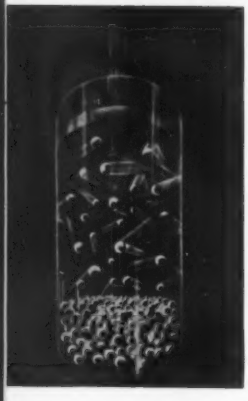

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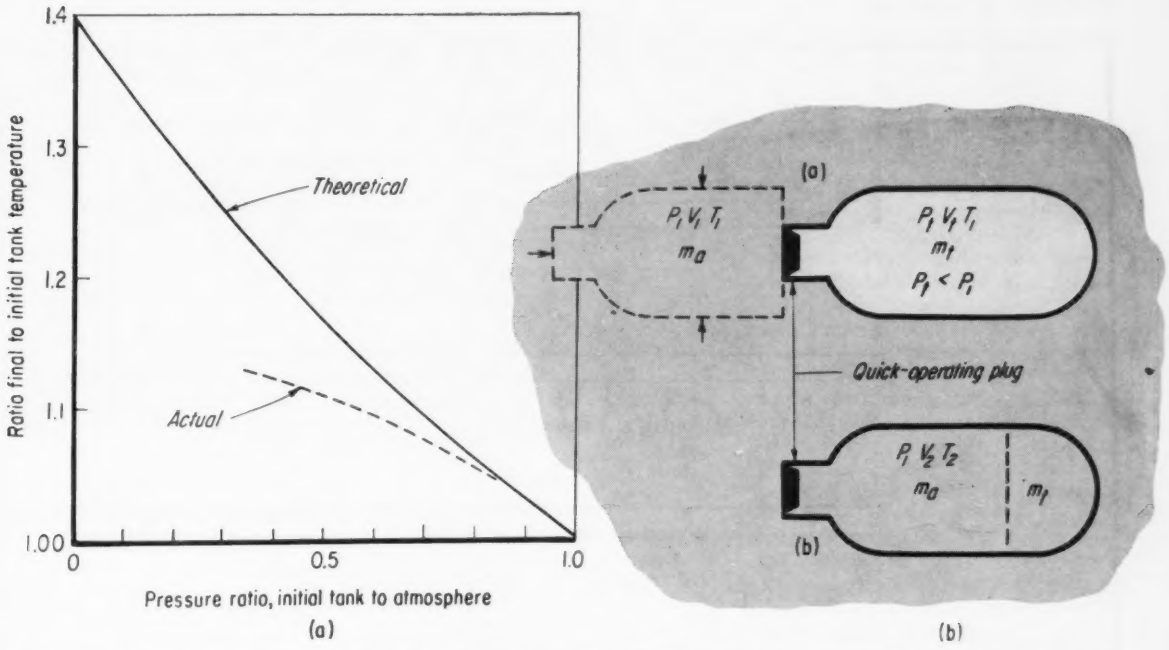

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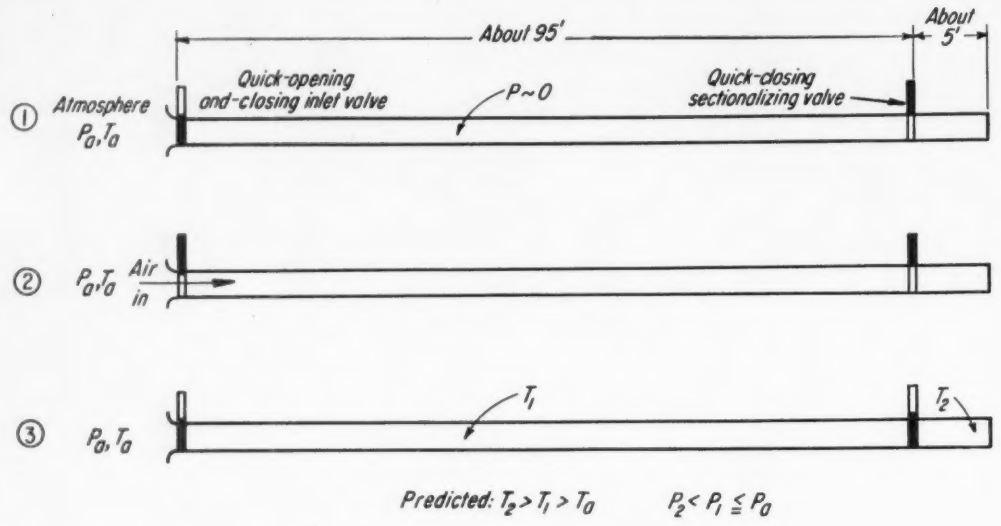

Has anyone performed this experiment?

This experiment using a length of pipe and two quick-closing valves might demonstrate the separation of molecules during transient flow because of the Maxwell velocity distribution, POWER, February 1957, p 210. This is an extension of the vacuum-bottle experiment in Fig. 2.

A length of pipe closed at one end has a quick-opening and -closing inlet valve at open end and a quick-closing sectionalizing valve near closed end to isolate a relatively small chamber.

To start the experiment, close the inlet valve and keep the sectionalizing valve open as in Step 1 above, and pump the pipe down to as near a perfect vacuum as possible.

In Step 2 open the inlet valve instantaneously and immediately slam shut both inlet and sectionalizing valves. This operation must be done in a fraction of a second—the shorter the pipe length, the shorter the time.

In Step 3 we expect to find the temperature in the small chamber higher than the temperature in the large section, and both higher than atmospheric temperature where the air originated.

Theoretically, the fastest molecules should reach the closed pipe end first, leaving slower molecules behind in the first section, separated by the sectionalizing valve. The end chamber trapping the fastest molecules should be hottest, while main chamber holding a mixture of fast and slower molecules should not be as hot.

POWER would like to know if anyone has performed this or a similar experiment.

perfect vacuum in the flask; the flask initially contains a small amount of air m_t at a state P_t, V_t, T_1. This mass gets compressed by the incoming air m_a and has a common final state with it of P_1, V_2, T_2. Conventional thermodynamic theory assumes that the atmosphere does flow work on the mass m_a entering the tank; this mass takes with it the flow work energy and its own original internal energy E_{a1} when it enters the flask.

Then accounting for all the energy before and after the process, which must be equal according to first law:

$$m_a E_{a1} + m_t E_{t1} + \frac{m_a P_1 V_{a1}}{J} = m_a E_{a2} + m_t E_{t2} \quad (11)$$

Substituting $PV = RT$ and $E = c_v T$ we get:

$$m_a \frac{RT_1}{J} = (m_a + m_t) c_v (T_2 - T_1) \quad (12)$$

Substituting $R/Jc_v = k - 1$; clearing:

$$\frac{m_a}{m_a + m_t} = \frac{1}{k-1}\left(\frac{T_2}{T_1} - 1\right) \quad (13)$$

Now to eliminate the masses in favor of the pressures they exert, let S_t = flask volume, cu ft; then the specific volumes of m_t and $m_t + m_a$ are:

$$V_t = \frac{S_t}{m_t} = \frac{RT_1}{P_t} \quad (14)$$

$$V_{t+a} = \frac{S_t}{m_a + m_t} = \frac{RT_2}{P_1} \quad (15)$$

Then from (14) and (15):

$$S_t = m_t \frac{RT_1}{P_t} = (m_a + m_t)\frac{RT_2}{P_1} \quad (16)$$

Clearing and transposing we have:

$$\frac{m_a}{m_a + m_t} = 1 - \frac{T_2 P_t}{T_1 P_1} \quad (17)$$

continued

Hall Industrial Water Report

VOLUME 7 MARCH 1959 NUMBER 2

Let's Keep Steamed Up

Large or small, the boiler house is the heart of most industrial plants. It must make steam to maintain production. When there is trouble, production losses from lack of process steam or power may be far more costly than the actual repairs.

Water problems are high on the list of the causes of unscheduled boiler house outages. To minimize these problems, skilled Hall engineers are ready to help you establish a sound, practical water conditioning program. And they can help you with other water problems in cooling systems, process operations and waste disposal.

Spreading Oil on the Water

Due to construction work, a small plant had only one boiler available. Then a fuel oil heater sprung a leak. Suddenly the one boiler had about 200 gallons of oil in it.

Ordinarily the boiler would have been shut down for a complete cleaning. However, that was not considered possible at the time of the accident. Recognizing that he was in real trouble, the engineer called Hall Laboratories.

Fast action was necessary. Most of the oil had to be removed from the boiler without taking it out of service for more than a few hours at night. Hall engineer C. F. Raines fed large quantities of caustic soda and wetting agent while lightly firing the boiler, venting steam to the atmosphere and blowing down heavily. Then the boiler was overflowed through the vent. This took from midnight until 4:00 a.m.

When the boiler was put back on the line at 5:30 a.m., the usual zeolite-treated feedwater was replaced with hard raw water so sludge to absorb oil would be produced in the boiler water. Several days later there was time over a week-end to do a more complete boiling-out job.

In spite of the heavy oil contamination the emergency action kept the boiler in service. Furthermore, when a quick inspection was made after the week-end boil-out there was no evidence of oil on the internal surfaces.

Well Water Changes For the Worse

About three years ago there was a radical change in the well water used by an eastern town. Hardness soared from a constant 8 to 9 gpg to a fluctuating 25 to 40 gpg.

A small local factory had successfully used the softer well water for boiler feedwater by pretreating it with lime and soda ash in a hot-process softener. Trouble came with the new well water because the widely fluctuating, high hardness made adequate control of chemical feeds well-nigh impossible. Calcium carbonate deposition completely plugged the vent condenser on the deaerating heater and stopped a feed pump by causing it to bind.

Hall engineer F. R. Duesing recognized that water conditioning procedures would have to be adjusted to accommodate fluctuating hardness of the feedwater. He therefore used a dispersive to stop the deposition of calcium carbonate in the pre-boiler system. This was the answer. After more than two years' operation there has been no further scale formation on the feed pumps or deaerator vent condenser.

Blowdown was another problem. It was excessively high because of the high solids concentration of the treated well water. By instituting the use of Hagan C-1 Antifoam, Duesing was successful in doubling the normal concentration of dissolved solids in the boiler water without impairment of steam quality. Subsequent inspections of the turbine and boiler superheaters have confirmed that steam quality is good.

Removing Old Scale From Boilers

Scale forms in a boiler in response to specific physical and chemical circumstances. Significant changes in water composition, chemicals used for conditioning, or amounts of chemicals fed can cause the scale to slough off. Accumulation of loosened scale can then upset circulation, obstruct blowdown connections, plug tubes and headers and result in unsafe operation and repairs.

To avoid trouble, a plant with dirty boilers should preferably clean them mechanically or chemically before changing to a more effective water conditioning program. If this is not possible for some reason, such as steam load requiring that all boilers be kept in service, the recommendations of the Hall engineer should be closely followed. He will base his recommendations for establishing desired boiler water conditions on his experience in getting rid of old deposits slowly enough to avoid serious difficulty.

Thermocouples Tell Tube Failure Story

Thermocouples, used to record tube temperatures, were resorted to by a midwest paper mill to warn of scale deposition in the water walls of their boiler. Sludge and sodium aluminum silicate (analcite) scale had caused trouble, and zeolite softening of makeup water didn't stop the analcite. Readings showed tube temperatures went from 450F to over 550F in 60 days.

Hall engineer M. L. Mitchell recommended a newly developed Hagan dispersive which is especially effective in promoting tube rinsing in regions of high heat transfer. The results were dramatic. Tube temperatures leveled off—and when the boiler was next cleaned, continued use kept temperatures at normal levels.

Water is your industry's most important raw material. Use it wisely.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information on how the Hall System can help you solve your particular water problems, write, wire or call address below.

HALL LABORATORIES
DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

For more facts circle 290 on Reader Service Card, p 122

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For more facts circle 291 on Reader Service Card, p 122

Unsteady air

Continued from page 154

Equating (13) and (15):

$$1-\frac{T_2}{T_1}\frac{P_t}{P_1}=\frac{1}{k-1}\left(\frac{T_2}{T_1}-1\right) \quad (18)$$

Substituting pressure and temperature ratio symbols:

$$1-T_rP_r=\frac{1}{k-1}(T_r-1) \quad (19)$$

$$T_r=\frac{k}{1+P_r(k-1)} \quad (20)$$

This equation gives us the temperature rise in the flask for given initial pressure ratios in the flask before admitting air. Fig. 2*a* shows the corresponding curve, marked *theoretical*.

The *actual* curve in Fig. 2*a* shows the experimental results. Final trapped-air temperature never becomes quite as hot as predicted. Again predictions may be too high because of the thermodynamic assumptions made of homogeneous action of the atmosphere on the air entering.

Offering an alternative molecular explanation, we again turn to the Maxwell velocity distribution as a possibility. Before the flask is opened, molecules with a wide range of speeds collide with the plug. When we momentarily remove the plug, the fastest molecules get in first; if we replug quickly enough we keep out the slower molecules. This raises the average temperature of the molecules trapped in the flask higher than that of the atmosphere where they originated.

As we start with lower pressures, that is, less m_t in the flask, there is less diluting effect on the entering fast molecules and so we get higher flask temperatures. With zero initial flask pressure and making the entering molecules travel a longer path, we theoretically could get better separation between fast and slow molecules. The experiment suggested on the preceding page could cause such a separation and confirm this hypothesis if it's correct. If you know of such an experiment, or a similar one, let us know what the results were.

Next part deals with elementary gas-turbine theory—in next issue.

Fish get special attention at the Priest Rapids Dam and hydro development. Special currents will be generated to guide them to ladders.

circle 292 on Reader Service Card, p 122 ➤

Protruding conduit boxes are gone. Cable comes through the base, leaving plenty of room for connecting motor leads.

By merely removing the end panels, you can see and inspect windings and bearing assemblies. Bearing assemblies come apart quickly for inspection. Remove bearing cap, top bearing shell and oil ring; then the bottom bearing shell rolls out for quick, easy bearing inspection.

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- Now, when you specify an FA Motor, the outlines and dimensions are immediately available.
- Now, independence of housing from the stator enables you to make complete visual

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inspections of the windings.

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• Exclusive plunge-bored brackets permit precision alignment of bearings. Each time the motor is reassembled, these brackets precisely maintain alignment of the rotor.

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• Thermalastic® insulation, an exclusive feature in all Westinghouse large motors, adds further insurance that you're getting the very best in motor quality and performance. Since 1949, Thermalastic insulation has extended the service life of coils in large motors, generators and other large electrical rotating apparatus.

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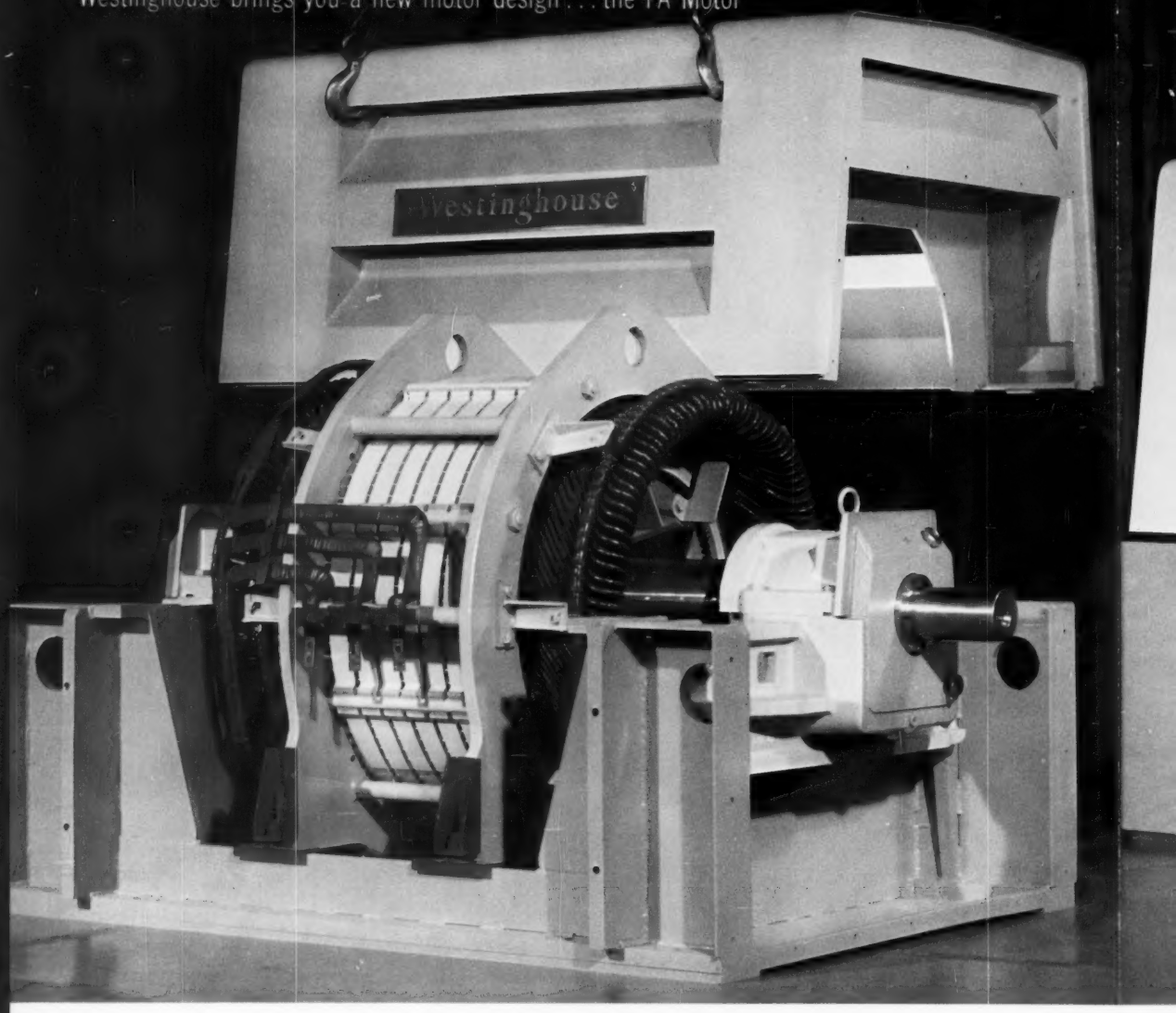
Westinghouse brings you a new motor design . . . the FA Motor



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takes guesswork out of inspection to save you hours per year on scheduled maintenance

This modern motor concept combines the well-known reliability of Westinghouse large motors with a new and vitally important extra—full accessibility!

For the first time, the motor housing is completely separate from the stator, with all the benefits such construction implies. Inspection—once a matter of partial visibility and guesswork—is now an easy and thorough operation which insures your motor investment and cuts costly down time for maintenance.

YOU CAN BE SURE...IF IT'S

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WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS"—CBS TV MONDAYS

The new Westinghouse FA Motor gives you five Bonus Values

1. Full accessibility. Total inspection is possible for the first time. Enclosures are quickly removed, easily replaced. Reassembly is automatically precise. Cuts down time by hours.
2. Inherently quiet. Housing is isolated from the stator, reducing transmission of vibration and noise.
3. Thermalastic insulation. Recognized as the finest available, it assures long life and protection of coils.
4. The same basic components—rotor, stator and bearings—which have made Westinghouse motors famous for long, efficient service life.
5. Easy to connect. No conduit box. Cables pass through the base bottom with extra-ample room to connect motor leads.

These qualities make the FA Motor your best investment. It is available in ratings from 250 hp up to 7000 hp, depending on speed. For full information, call your Westinghouse representative or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. JI-15005-R

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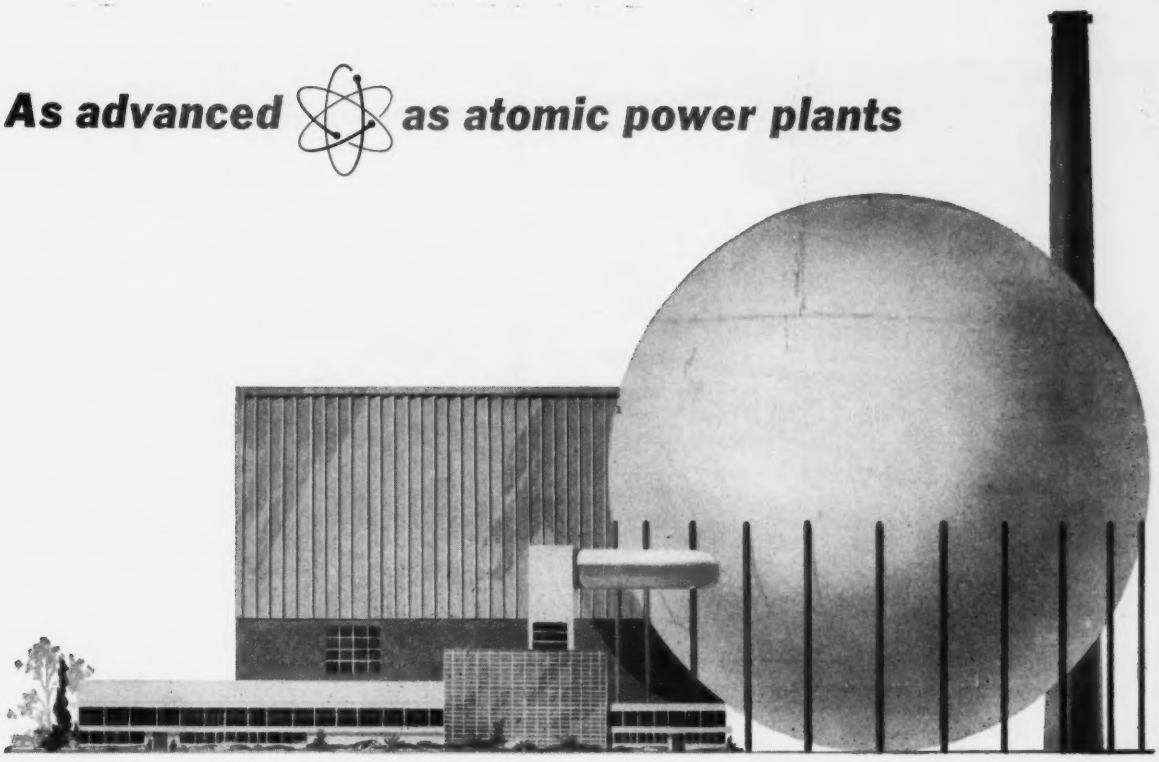
As advanced as atomic power plants



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treat boiling water reactor condensate at

50 GPM PER SQUARE FOOT

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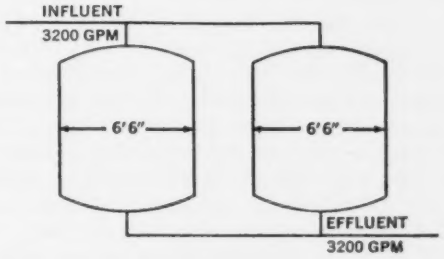
The plant design is based upon extensive pilot plant studies using a 24" diameter unit to treat unfiltered condensate at 200 gpm (68 gpm per sq. ft.). The equipment and techniques developed for this plant are also applicable to high pressure conventional and super-critical pressure plants.

Results of pilot plant studies and design features of this ultra-modern installation will be sent free upon request. Write today for Reprint #88.



Infilco Inc., General Offices: Tucson, Arizona, P.O. Box 5033
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INFILCO

"Eminence in equipment design for water, sewage, and waste treatment . . . since 1894."

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"The building engineer and his fireman rushed out of the boiler room, coughing and gasping for air," roared Marmaduke

Marmy's constipated stack

"BILGEWATER on diverting the Gulf Stream to get rid of England's fog," roared Marmaduke Surfaceblow in his gravelly voice last night at the Bent Propeller Bar. "I'll tell you push-button engineers about the time I put a simple law of physics to work instead of a couple of knucklehead muscle-bound riggers."

Don't ask me what brought on this outburst. I had just dropped into that famous waterfront hangout with my former shipmate Stan O'Leary. We had hoped to talk ships and do a little reminiscing. But just as we leaned on the crowded bar and ordered two beers, that cantankerous old consulting engineer wearing his battered gray derby banged his huge right fist on the bar and let go his blast. So Stan and I fixed our eyes on Marmy, as did everyone else. Satisfied he had the floor, he continued.

"All hell broke loose one evening at 3 pm while I was chief engineer of the Snowhite Laundry in Chicago," blasted Marmy. "That was back in 1915. I was drinking coffee with the foreman of the finishing department on the second floor and looking through the window at the Washington Irving School across the street. The school bell rang dismissal and kids came pouring out of the building yelling and whooping it up.

"But suddenly black clouds of smoke started billowing from the boiler-room windows and doors of the school.

" 'Holy mermaids,' I yelled at the foreman, 'look at that.'

"Before he could say anything I went tearing through the finishing department and around the laundry building to the school's boiler-room entrance. By then bells were clanging as two fire engines came tearing down the street.

"Just as a fire engine pulled up, my good friend Ray Bates, the school-building custodian, and his fireman staggered out of the boiler room, coughing and gasping for air. Ray weighed about 260 pounds and had a long black handle-bar mustache.

" 'The school ain't on fire, it's that damned incinerator,' coughed Ray as tears streamed down his face and dripped off the ends of his mustache. 'Maybe a damper or something's closed, or that smoke would go up her stack.'

"By then firemen and school kids were all around us. The firemen ran into the boiler room with their smoke-masks and opened all the windows. Smoke kept pouring out of the incinerator, escaping through the windows and doors. Ray had his fireman run back inside and kill the incinerator fire.

" 'The spark arrester must be plugged,' puffed Ray, wiping his face with a red bandanna.

" 'Sure, that's it,' agreed the fire chief, happy to leave.

"Before long the smoke cleared and the fire engines and the children left. Ray and I got busy and started to

ALLIS-CHALMERS ACQUIRES S. MORGAN SMITH ...FORMS NEW HYDRAULIC DIVISION

On February 1, the S. Morgan Smith Company became a part of Allis-Chalmers. Extensive A-C facilities in Milwaukee, together with two S. Morgan Smith plants in York, Pennsylvania, are now operating as the newly created Allis-Chalmers Hydraulic Division.

In acquiring S. Morgan Smith, A-C combines its own broad background in hydraulics with the 80 years of diversified engineering and manufacturing knowledge of SMS.

The York facilities will be devoted to the continued research, design, engineering and fabrication of a complete line of hydraulic turbines and accessories, pumps and pump-turbines, valves for industrial, waterworks and power applications, and specialized heavy equipment.

Product information or engineering help can be obtained from your nearby Allis-Chalmers office, or by writing Allis-Chalmers, Hydraulic Division, York, Pennsylvania.

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Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

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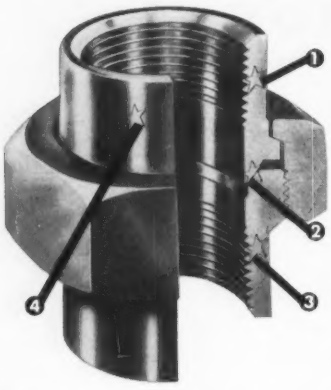
gives you all these features for your forged steel pipe union requirements



1. **Uniform walls** for even expansion and contraction under temperature changes. They follow the pipe!

2. **Catawissa Ball-to-Angle Seats** give you a "Perfect Seal" regardless of pipe alignment!

3. **More than adequate** wall thicknesses give you Catawissa's 3-to-1 Safety Factor (3000-lb. service, 9000-lb. test; 6000-lb. service, 18000-lb. test)!

4. **Round, straight barrels** for fast wrenching. No uneven or tapered surfaces to cause wrench slips or wrench locking!

Catawissa Perfect Seal Pipe Unions are made by Union Specialists from 80,000 lb. tensile strength steel (ASTM Spec. A-105-55T, Grade II). Steel forgings from our own forging mill are closely checked for imperfections . . . and finishing on modern, automatic machines with close inspection during and after production give you pipe unions second to none!

Write for Catalog 58 showing the complete Catawissa line of Perfect Seal Products.

for complete, guaranteed satisfaction

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Marmaduke

Continued from page 162

check why incinerator didn't work.

"First we looked for blockage in the back connection of the incinerator and the flue pipe. But, as far as we could find, they were clear. Then we looked for the spark arrester, but couldn't find it. Ray had his fireman open the inspection door on the incinerator stack. The stack looked clear up to about the third floor, but he said he couldn't see daylight. So we figured the blockage was at that point.

"When we checked the building prints in Ray's office, we learned that the stack was 20-in. square. It ran straight up inside the building for about 80 ft. Then it had a 7-ft long offset with two 45-degree bends, joining the boiler stack at the roof. There the two brick stacks ran side by side, straight up for another 37 ft, but inside a round steel casing.

"Trouble was that the steel casing was capped with a 7-ft high ornamental sheet-metal hood. And the spark arrester was on top of the brick chimney, 7 ft below that flimsy hood. Getting to the spark arrester, even if we did have a 50-ft ladder and could get it up on the roof, didn't look easy.

"'Let's get a cup of coffee and think this over,' I said to Ray. 'There must be a way to clear that spark arrester without calling in a rigger.'

"Ray agreed because it was late Friday and nothing could be done until Monday morning anyway. Even then he'd have to have the supervisor of custodians' okay from the board of education.

"'I got it,' suddenly yelled Ray, slamming down his cup. 'We were burning all those election ballots from last week. They're light as tissue. I'll bet the incinerator heated up in a hurry from those thin ballot sheets and a lot of partly burned ballots floated up with the high draft to the spark arrester, plugging it solid.'

"'If that's the trouble and not a lot of soot sticking to the arrester,' I answered, 'your problem isn't too bad.'

"'Oh yeah?' chimed in Ray skeptically, 'and how do you figure that?'

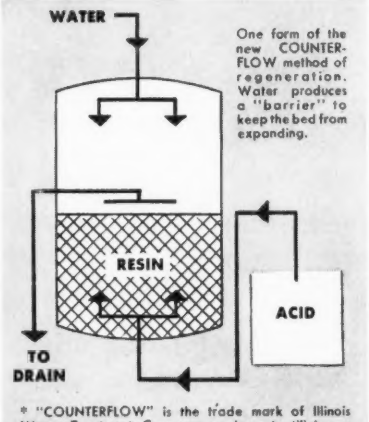
"'Because,' I answered, 'it took a high negative pressure to float all that paper up there, so a negative pressure can bring it right back down again.'

"'You mean reverse the draft in that stack?' asked Ray, blinking his eyes in disbelief.

continued

ILLCO-WAY
ionXchange

COUNTERFLOW*
REGENERATION OF ION-EXCHANGERS



One form of the new COUNTERFLOW method of regeneration. Water produces a "barrier" to keep the bed from expanding.

* "COUNTERFLOW" is the trade mark of Illinois Water Treatment Company equipment utilizing a distinctly new principle of regeneration. Pat. pending.

"COUNTERFLOW" is a method whereby upward regeneration, which has long been recognized as most desirable, is successfully accomplished by establishing a "barrier" at the resin face.

LOOK AT THESE
RESULTS!

- De-ionizer in a power plant. Conductivity of effluent improved from 10 micromhos to 4 micromhos after conversion to COUNTERFLOW. Cation leakage, expected at 4 ppm with downflow regeneration, actually is only 1 ppm.
- Chemical company in Middle West, 480 ppm TDS in raw water. Expected cation leakage with conventional regeneration, 9 ppm; with COUNTERFLOW, only 1.2 ppm.
- Distillery in Middle West. TDS in raw water, 575 ppm. Expected cation leakage with conventional equipment, 6 ppm; with COUNTERFLOW, is actually only 1.5 ppm.
- Western power plant, converted to COUNTERFLOW. Savings in acid reduction, $16,000.00 per year. TDS in raw water, 342 ppm. Predicted cation leakage from curves for conventional design equipment, 4 ppm; with COUNTERFLOW, actually only 1.6 ppm.

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NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
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circle 295 on Reader Service Card, p 122

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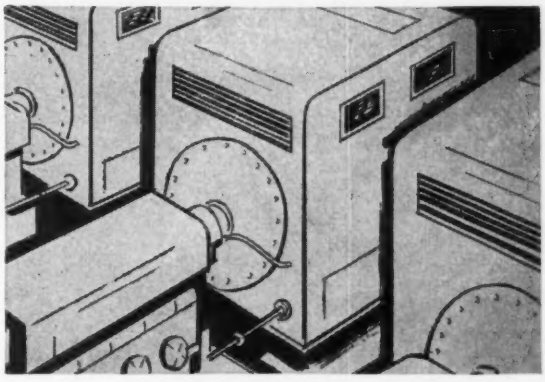
Here's why you save by specifying Silicone Insulated Drive Motors

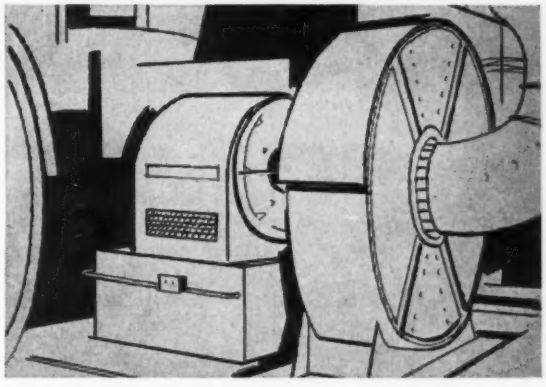
They're More Reliable

Utility engineers report that auxiliary drive motors carry 30% to 50% overloads without strain when they're designed to use the extra thermal stability of Dow Corning Silicones to increase service factor. That's greater assurance of service continuity than possible with any other insulation! This same thermal stability means top reliability in high ambient areas. Silicone insulated motors keep going despite overloads and ambients that cause other motors to fail.



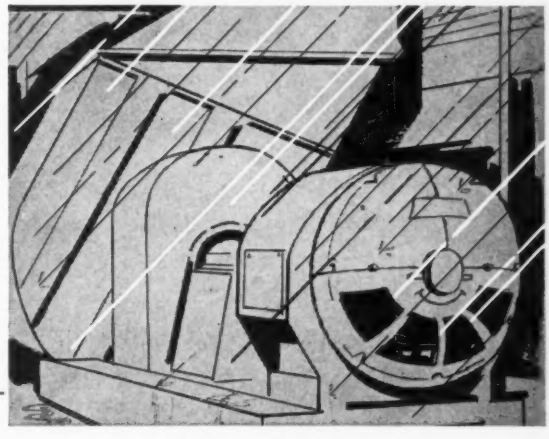
Smaller Motors Do The Job

By specifying motors with horsepower ratings matched to normal loads and letting the increased service factors provided by silicones carry the overloads, many companies now pay less for auxiliary drive motors. Following this practice, savings are realized not only in initial equipment costs . . . but in operating costs as well. Part-load inefficiencies and poor power factor resulting from overmotoring are eliminated. And, because silicone insulated motors pack more horsepower per frame size, mountings are smaller, less costly . . . installation problems minimized.



Simplified Enclosures Cost Less

Silicone insulated motors cost substantially less than other motors built for outdoor service. The reason: much lower enclosure costs because of "self-protecting" insulation systems made with Silastic, the Dow Corning silicone rubber. Specify open frames! There's no need for a premium priced enclosure to protect the insulation. Silicone rubber insulated open motors withstand torrential rains, hurricane winds, corrosive fumes, dust, snow, sleet, cold, heat . . . even flooding.



Send today for free brochure detailing how you can save with silicone insulated motors. Includes up-to-date list of manufacturers offering equipment insulated with Dow Corning Silicones.

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Marmaduke

Continued from page 164

"'Sure,' I answered, 'Why not?'

"'And how do you expect to do that, put the building on fire?' chimed in Ray sarcastically.

"'That's one way,' I answered, 'but my way is simpler. I'd see if I could use those fans.'

"While Ray let that idea float around inside his noggin, I studied the blueprints again. I saw that there was an auditorium blower and exhauster in the roof penthouse and another auditorium exhaust fan in the boiler room. Their total capacity was about 30,000 cfm. All I had to do was close dampers and open the inspection doors on the blower's housing and then open auditorium windows to make an exhaust fan out of the blower.

"As luck would have it, the stairs leading from the boiler room directly up to the penthouse were in a stairwell. That made a giant U-tube, with the stack as one leg and the stairwell as the other, connected at the bottom by the boiler room.

"'Look here, Ray,' I said, shoving the blueprint under his nose. 'All you gotta do is block off every opening going into the stairwell and the boiler room. Then start these fans. They'll remove enough air to pull a negative pressure in the stack.'

"Ray got the idea. He and his fireman got hot and blocked the first, second and third floor stairwell doors in the closed position, opened the boiler and penthouse doors at the two ends of the stairwell and closed all the boiler-room windows.

"I had them close the fresh air intake of the 12,700-cfm auditorium blower and open the fan's inspection doors on both sides of its heating coils. Then they closed the recirculating damper between the auditorium blower and the auditorium exhaust fan. Next they opened some of the auditorium windows.

"The auditorium blower was started. That made it take suction through the two open inspection doors and discharge air into the auditorium and out into the atmosphere through the opened auditorium windows. This prevented a positive pressure from building up in the auditorium which would have cut down the capacity of the blower.

"Before long Ray had all the fans

circle 299 on Reader Service Card, p 122 ➤

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UNUSUAL DURABILITY
HIGH LEVEL DISCHARGE
BIG PLANT CAPACITY

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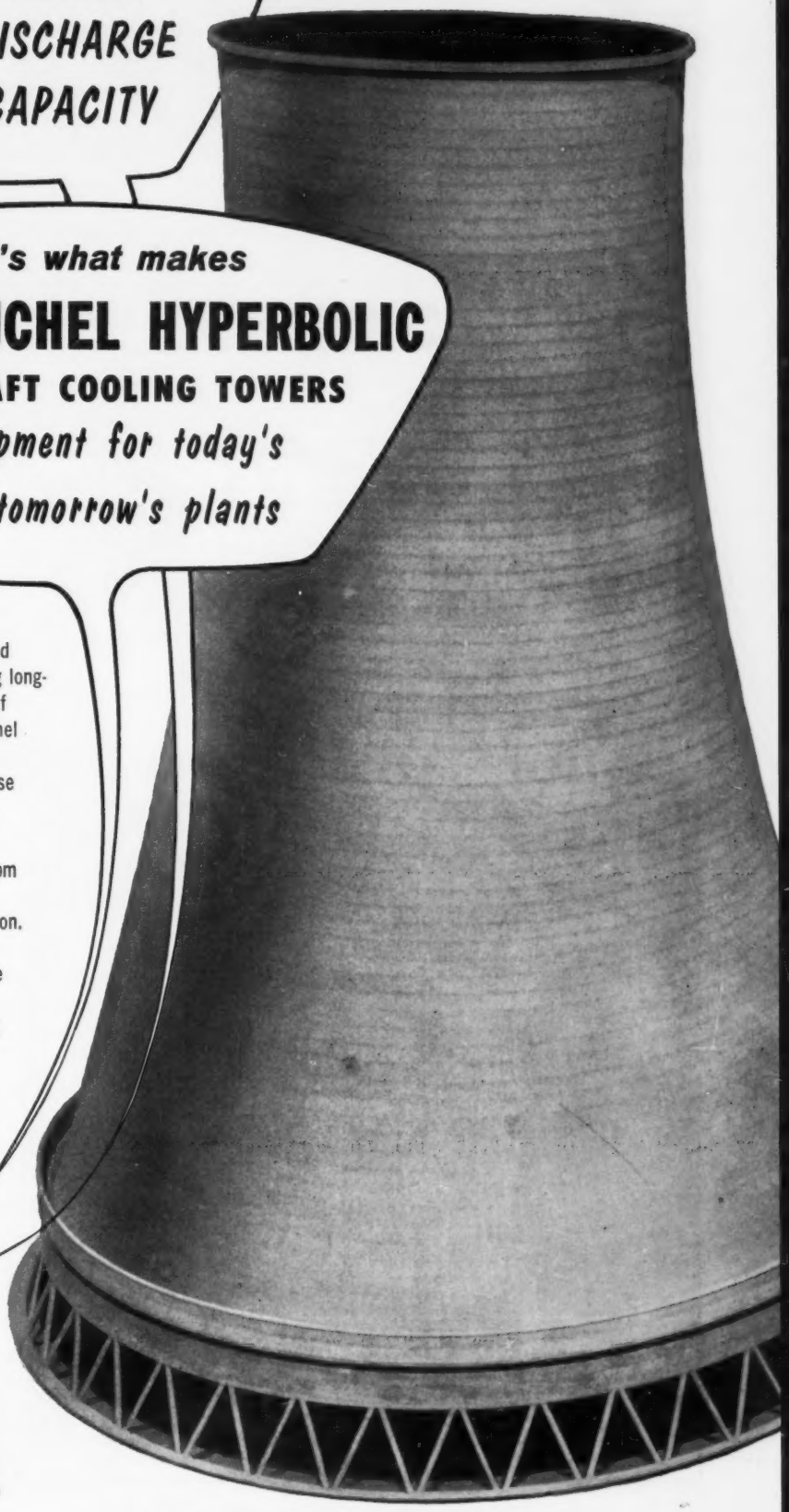
NATURAL DRAFT COOLING TOWERS

perfect equipment for today's designs for tomorrow's plants



Generating stations now in planning stage and those of the future will demand larger investment in plant and land, making long-term amortization and space economy of paramount importance. The Marley-Mouchel concrete tower fits these requirements precisely. The rugged durability of these natural draft towers is historical—based on experience on four continents.

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Particularly if your plans are in the 100 mgw production range or larger, you should investigate Marley-Mouchel Hyperbolics; they have the capacity per unit to match large scale generating equipment.

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The Marley Company Kansas City, Missouri

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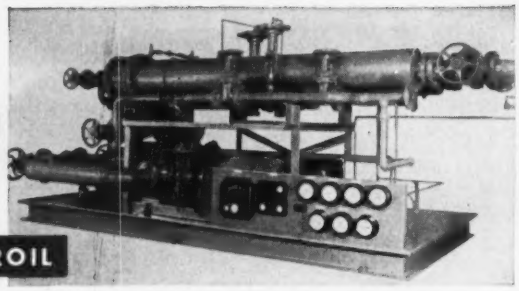
NATIONAL AIROIL



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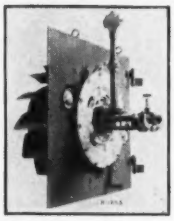

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McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

Marmaduke

Continued from page 166

running, exhausting air from stairwell and boiler room. That drew air out of incinerator and from the blocked stack. While waiting for the fans to produce enough negative pressure, Ray and his fireman went around plugging up small openings that might leak air into the stairwell or boiler room. All openings on the coal-burning heating boilers were closed or stuffed with rags. Wide cracks under doors were also stuffed.

"After about a half hour of plugging all possible openings, from the penthouse right down to the boiler room, the three of us settled down for a smoke near the incinerator while we waited to see what would happen.

"Ray was getting jittery and looked at me hopelessly. 'I guess it's no use, Marmy,' he finally wailed. 'This looks too easy to work. Those fans have been running long enough to collapse the whole building.'

" 'Let 'em run another half hour,' I suggested. 'There must be a lot of small leaks we didn't plug.'

"But just as I said that, there was a loud crash in the incinerator. Sounded as if a bale of paper came tumbling down its stack. Then large chunks of partly burned paper and soot shot out onto the boiler-room floor. Ray almost swallowed his pipe.

" 'Now I've seen everything,' he grunted excitedly, slapping me on the back. 'Clean up that mess while I shut down the fans and unblock the doors and dampers,' he yelled at his fireman.

"When the boiler-room windows were opened Ray started a fire in the incinerator. 'She's got more draft then ever before,' beamed Ray, smiling from ear to ear."

Marmy stopped sounding off and turned back to the bar to ballast his double-bottoms from his bottle of Sandpaper Gin. Then he smacked the bar again and roared, "Those fans did the trick. They not only got Ray out of a hole but saved his school a chunk of money besides. And all I did was reverse the air pressure that blocked the stack in the first place."

—*SME*

JM FANS

We in the Johns-Manville home office get a kick out of the Marmy stories.

T M JACKSON JR, *New York City*

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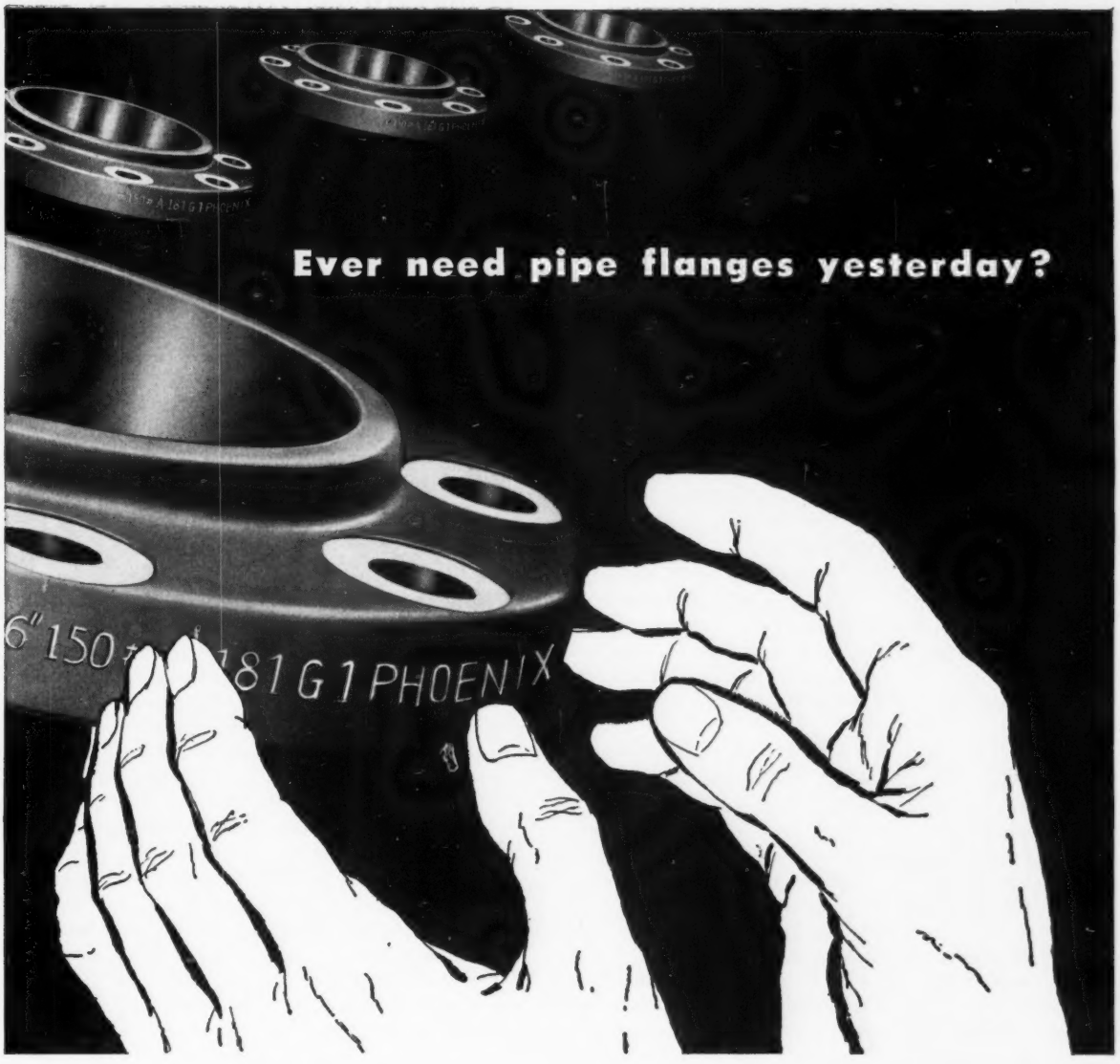

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Powerscope . . . A selective look at

Out of industry's hatchery comes . . .

. . . a revolutionary heating system for houses, plants and commercial buildings that uses electric power during off-peak hours to provide a constant stream of warm air 24 hr a day. System eliminates chimneys, ashes, fuel tanks, boiler rooms and virtually all noise. It operates by generating heat from electricity in elements that are embedded in a storage pile of specially formulated materials. A low-pressure blower delivers fresh, heated humidified air in an uninterrupted stream. Developer: Canadian Curtiss-Wright Ltd, Montreal.

. . . a cold-cathode gasless vacuum tube with an indefinite life span. Developed through joint efforts of U.S. Army Signal Corps and Tung-Sol Electric Inc, tube can idle on 5 millionths of a watt. It could be forerunner of a new line of general-purpose tubes for broad military, industry, civilian use.

. . . first isolated-phase bus run capable of operating at the highest thermal rating ever specified for a generator conductor. Built by General Electric Company, it will be installed at Tampa Electric Company's Gannon Station, Sutton, Fla. The bus duct will operate at a maximum hot-spot temperature of 105 C.

. . . the world's first inner-cooled transformer —a Westinghouse Electric Corp development. Oil is circulated between strands of parallel conductors that are at the same potential. Thus oil ducts are eliminated between coils and windings. This allows use of materials having higher insulation strength than oil where voltage stresses occur. Unit is on N. Y. State Electric & Gas Corp system.

. . . word of an electronic "talk back" system which allows pupils in a classroom to question or recite to a teacher in a television studio. System is designed to overcome what has been a principal weakness of educational TV—the lack of any means for students to communicate directly with instructors and, secondly, for teachers to get to know their pupils, ascertain their progress and gage teaching pace according to student reaction.

. . . a Westinghouse Electric Corp process of annealing by a continuous strip to produce electrical steel sheets with a high degree of flatness, impossible to obtain by conventional annealing methods. Transformer cores built with this flatter material are under less strain when clamped in place, resulting in lower sound and lower losses.

. . . a turbine rotor-balancing method developed by General Electric Company that cuts cost and assembly time—by more than 50% —on rotors of gas-turbine aircraft engines. In former method, turbine rotor was balanced by picking and choosing blades until right ones were found. In new scheme, 10 to 15 miniature, sintered metal slugs are installed with tweezers on each rotor at points of unbalance determined beforehand by (1) balancing equipment and (2) unique analytical technique developed by GE engineers.

Science on Saturdays . . .

. . . is proving popular at Columbia U where 158 students, 12 to 18 years old, are participating in a science honors program. Every Saturday they attend free lectures by Columbia professors and conduct supervised laboratory experiments. Purpose of the program: To make the best science available to the best minds and to set an example that all colleges and school systems can follow.

Average college graduate of a decade ago has not changed his employer since receiving a sheepskin and he would not switch his allegiance to another alma mater. That's the report of Lehigh U's class of 1948 following a poll in which 243 members participated. Average '48er is earning about $10,000, works for a company with over 500 employees, is doing work in the field in which he majored and would select Lehigh to take the same course if he were a freshman applicant.

Q. What factors contribute to the success of a young engineer?

A. Spatial vision, advanced engineering and quantative ability . . . according to a year's experience with a "Personal Follow Program," conducted by Westinghouse Electric Corp. Program includes 1200 engineers with experience ranging from 1 to 6 years. Contrary to some beliefs, and to the surprise of those conducting the program, "external trappings," such as color of wall paint, amount of desk or office space, etc, were not influencing motivation factors.

National Science Foundation's latest R&D in Industry study provides some interesting statistics on engineers. Between 1954 and 1957 the number of employed engineers reported by industry increased by over 119,000. In same period, our colleges graduated some 71,000 first-degree engineers, or only 60% of our new engineering force.

this month's power-field happenings

ART SOMMER, Assistant Editor

Soviet's dream?

According to the director of Russia's Academy of Sciences, the U.S.S.R. will "soon be getting electric power directly from the sun, through the medium of semiconductors. These wonderful crystals will make it possible to supply every city and village in the country with all the electricity it requires."

An experimental 3000-kw turbine-generator with complete water cooling of stator and rotor has been manufactured at the Leningrad electrosila works, reports McGraw-Hill World News.

Remarks heard at AIEE's Winter General Meeting special session on Soviet education and technology: . . . Soviets have world's best service for distributing technical information, reported R K Honaman of Bell Telephone Laboratories. In citing the Russian "Institute of Information," Honaman pointed out that Soviet scientists and engineers probably receive about half of the world's available technical information through the vast collecting, translating and disseminating activities of the institute. No such service is as yet available to scientists and engineers in this country.

. . . some American leaders have "thrown wisdom to the winds and scientific method to the dogs" in a tendency to overestimate the Soviet educational system, stated Dr William W Brickman, a New York U professor of education. The claims made for Russian education have been accepted by many people "without question and without explanation," said Dr Brickman who recently returned from a visit to the U.S.S.R. "I feel," he said, "that American leaders have tended to overrate the foreign-language training programs of the Soviet schools, that we have overlooked the overlarge classes and the multiple sessions, that we did not take proper cognizance of the underpaid teachers in the lower grades and that we have shut our eyes to the supreme role of the Communist Party and Communist ideology in all aspects of Soviet education."

Signing on the dotted line

Griscom-Russell Company has received a multi-million dollar order from Atomics International for three steam generators to be put in service at the Hallam Nuclear Facility of the Consumers' Public Power District near Hallam, Nebr. G-R expects to ship the three units during the fall of 1960 for operation in 1961. The units will be made of chrome-moly alloys and carbon steels. Each generator will be composed of three principal elements: an evaporator section, steam-water separating device and superheating unit to operate together through interconnecting piping.

U.S. Army has awarded a $3¼ million contract to Alco Products, Inc, calling for construction of a transportable nuclear power plant for use in remote locations. (*Power*, Jan 1959, p 61.) The prefabricated plant, designed by Alco under a company-sponsored project, will consist of 20 to 30 packages that can be transported by air and assembled at any desired site. Its uranium core will provide fuel for one to two years' operation, generating 1500 net kilowatts of electricity for heat and power, plus about 1000 lb steam per hr.

Building today for tomorrow's needs

Pacific Power & Light Co, which has just completed a 100,000-kw generating unit near Glenrock, Wyo., will start construction in May on a second plant. The new unit, also with 100,000-kw capacity, will be located alongside the first and is expected to be placed in service by October 1961. Estimated cost of planned unit: $18 million.

McGraw-Hill World News reports from Hungary that a new electric substation—one of the largest in Europe—has gone on line on the outskirts of Budapest. The $13 million station has a 120,000-volt capacity which will be expanded to 340,000 volts later this year.

Monsanto Chemical Co will put industry's first computer-controlled chemical plant on stream during 1959, reports H K Nason, a Monsanto VP. By use of the computer, which will be installed in an existing manufacturing unit, Monsanto expects to achieve maximum productivity from its plant investment at minimum operating cost. The computer will achieve this by continually monitoring process conditions, making numerous calculations, automatically adjusting controls for best results.

Westinghouse Electric Corp will build a 5000-kw nuclear reactor plant for the General Public Utilities system for use at a power station now in operation near Saxton, Pa. Westinghouse has retained Gilbert Associates, Inc as subcontractors for engineering and construction of the facility.

PUMPS ON YOUR MIND?

Send for this VIKING Pump Data

VIKING ENGINEERING DATA — A 36-page pump engineering manual is yours for the asking. It fully explains the 10 easy steps in selecting Viking rotary pumps. Ask for catalog KW.

VIKING HEAVY DUTY PUMPS — Available in 10 to 1050 G.P.M. sizes, these rugged Vikings are suitable for pressures up to 200 P.S.I. Complete with specifications, performance data, etc., they are illustrated in the 24-page catalog CW.

VIKING GENERAL PURPOSE PUMPS — These Viking Pumps—in 2/3 to 1050 G.P.M. sizes—are suitable for pressures up to 100 PSI. They are fully illustrated and have specifications, performance data, etc., in the 36-page catalog BW.

All Viking Pumps are positive displacement pumps and deliver either thin or thick liquids.

VIKING—the leader, not a follower, in Rotary Pumps

VIKING PUMP COMPANY
Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" pumps

See Our Catalog in Sweet's Industrial Construction and Plant Engineer's File
For more facts circle 303 on Reader Service Card, p 122

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your costs go down

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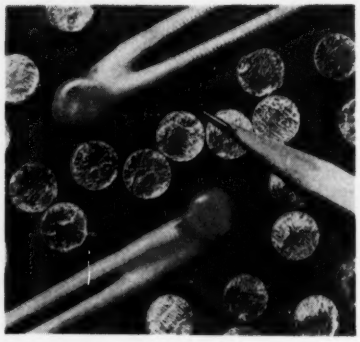
Reports from the field

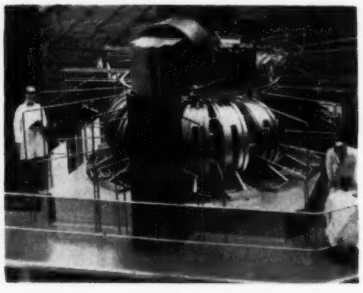


Solid-state device acts as contactless thermal switch

A new family of thermistors, whose resistance increases abruptly when a specified temperature is reached, has been developed by Westinghouse Electric Corporation. These thermistors provide a reliable, practical and precise system for over-temperature protection of hermetic motors in large air-conditioning and refrigeration systems.

Units are especially applicable to totally enclosed motors. Installed directly in the motor windings, they operate small external relays to de-energize the motor or give a signal when overheating occurs.

Produced as small ceramic disks, the size of an asperin tablet, they are surfaced on opposite faces with a metallic coating. Then they're fitted with leads, encapsulated in an epoxy resin, and are ready to go to work.



C Stellarator is new tool to further fusion study

Scale models of the C Stellarator test track help tell the story of controlled-fusion research at Princeton University. Stellarator will use hydrogen isotopes injected into a race-track-shaped vacuum vessel where hot plasma is confined by a 50,000-

For more facts circle 304 on Reader Service Card, p 122

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Values

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—DESIGNED FOR DEPENDABILITY

R-P&C "Sure-Tight" LUBROTITE GATE VALVES

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Lubrotite Gate Valves—created and patented by R-P&C—are built to provide absolute tightness and long, trouble-free service in handling all fluids for which iron and cast steel valves are serviceable.

By the unique Lubrotite system, in which each seat ring is served by a Lubrotite gun, a lubricant seal is forced through to the valve's seating surface. This lubricant prevents leakage, retards corrosion, prevents sticking, reduces wear on seating surfaces and makes for easier operation. Net result: reduced operating, maintenance and over-all valve costs!

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Lubrotite Gate Valves form a part of the complete R-P&C line, which includes gate, globe, angle and check valves in all standard materials; all in a wide range of sizes, styles and pressure classes. Order through nearby R-P&C Distributor. Write our Reading office for catalog.

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"How to Protect Your Valves"
Installation pointers, operating tips, clues to longer valve life. They are all on this 22" x 17" wall chart. Write for your free copy.

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For more facts circle 305 on Reader Service Card, p 122

SCHAUB DEAERATION
doesn't cost...it pays!

Removes feed water oxygen to a guaranteed .03 cc/liter

Assures a simpler system that costs less to own and operate

The Schaub .03 is, in fact, one of the simplest deaerators ever built, designed around a unique and more efficient operating principle that removes oxygen to an actual and GUARANTEED .03 cc/liter.

Fully vented operation at atmospheric pressure — combined with pinpoint temperature control and Schaub "live action" heating of storage water — provides a forceful breakaway of air molecules that assures more effective oxygen removal under widely varying load conditions. At the same time the special Schaub spray contact vent condensing principle practically nullifies steam losses.

The Schaub .03 is completely safe! It needs no premium cost pressure shell construction—requires neither adjustment nor attention during operation—and takes practically no maintenance whatever! Even the exclusive Chromasoid lining is guaranteed against shell corrosion failure for 10 years.

Finally, no pressure-vessel insurance premiums to pay — ever!

Whether you reckon in original cost or the operating savings you'll achieve, no other deaerator in the 3000 - 45,000 lb. range offers you so much protection for so little. For fuller information on the remarkable "hows" and "whys" and savings advantages of the Schaub .03 Deaerator method, send for Bulletin 1300.

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2105 S. Marshall Boulevard, Chicago 23, Illinois

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FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Blvd., Chicago 23, Illinois

Name.....

Company.....

Address.....

City.....Zone....State.....

Reports from the field

Begins on page 172

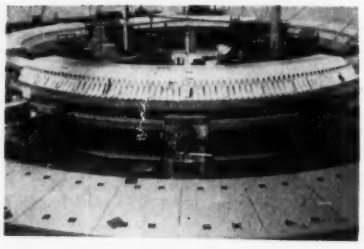
gauss magnetic field and then heated to extremely high temperatures.

Power for the model will come from three motor-generator sets, with flywheel storage, capable of producing 200,000 kw—built, like the rest of Stellarator's mechanical and electrical equipment, by Allis-Chalmers.

Model "C" won't turn out net power, but should provide info necessary for future fusion work.

Modern welding technique uses stream of electrons

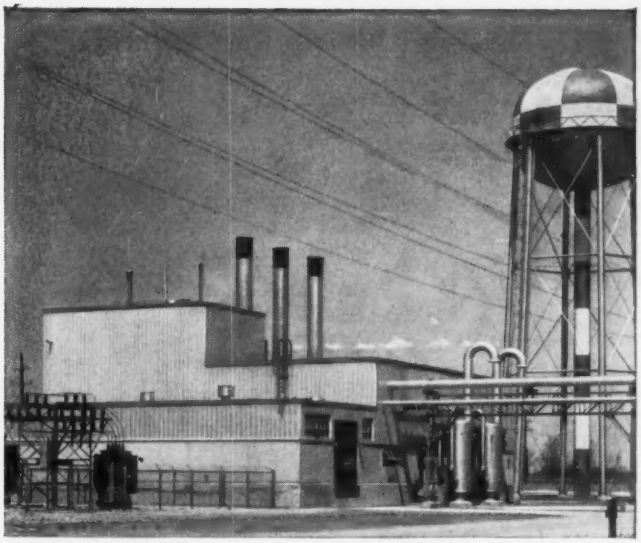
A focussed stream of electrons in an electron gun is used for welding in the pilot unit built by Nuclear Metals, Inc. The principle of operation is similar to that of a television tube. New process allows welding of most metals in vacuum.



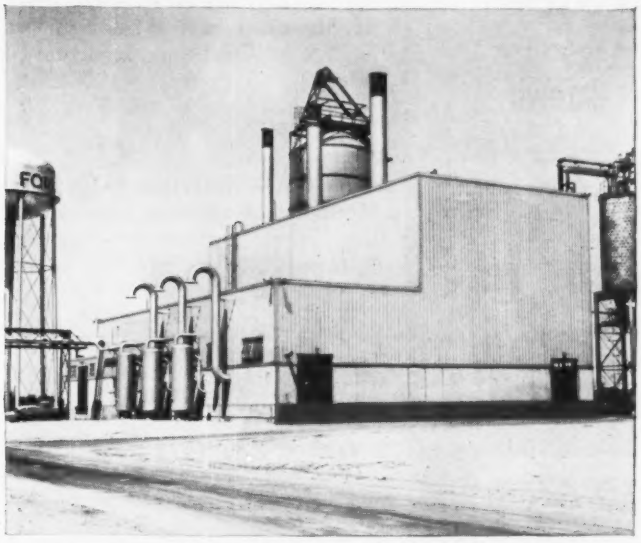
Cosmotron eats up cooling at 500 gal per minute

A 2000-ton electromagnet at Brookhaven National Lab spins protons around 75-ft orbital path three million times per second. Protons are held at energies up to three billion electron volts—greater than the energy of some cosmic rays.

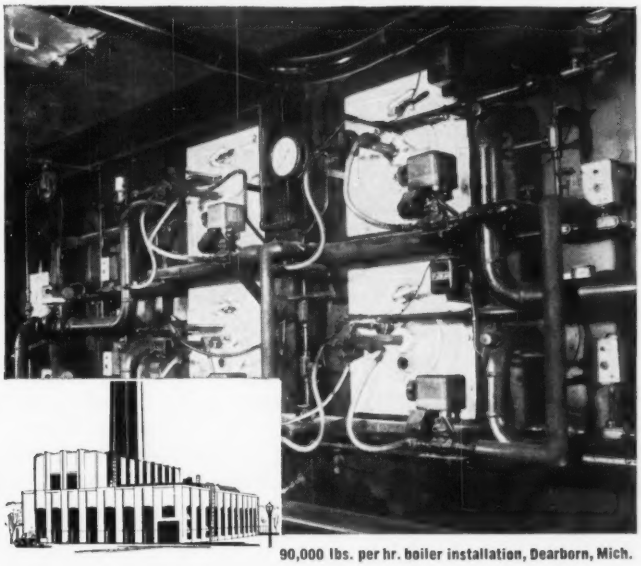
Electromagnet takes a lot of cool-



Steam and compressed air plant, Rawsonville, Michigan. Total capacity: 120,000 lbs. per hr.



Steam and compressed air plant, Indianapolis. Total capacity: 300,000 lbs. per hr.



90,000 lbs. per hr. boiler installation, Dearborn, Mich.

FORD POWERS UP with Pritchard-built power plants

What's the most important factor in an industrial power plant? Efficiency? Low investment cost?

The Ford Motor Co. will tell you it's neither factor—when considered separately. The highly efficient plant may have cost so much to build that its products—steam and air—are too expensive for the highly competitive automobile manufacturing business. On the other hand, the low cost plant may never operate efficiently and may be subject to frequent break-downs.

The first power plant built for Ford by J. F. Pritchard & Co. has shown a favorable operating cost-investment cost ratio. Since then, two more Ford power construction jobs have been completed by Pritchard.

Balancing investment costs with operating costs is basic to Pritchard's approach to power plant construction. This requires more than engineering skill alone—more than good construction—more than careful purchasing and coordination. It combines these factors in such a way that the completed plant costs least to own and operate in the long run.

If you are considering expansion or new construction, assign the job to Pritchard. Our services range from economic surveys to completion of turn-key jobs . . . our experience from the construction of industrial power plants to central stations.

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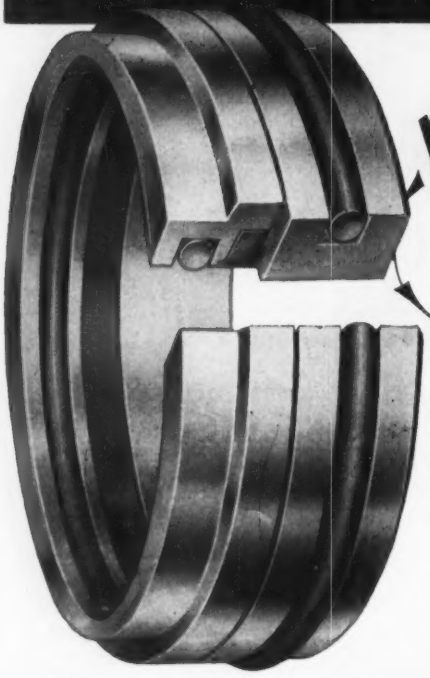

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Requires only 2 parts and two O-rings

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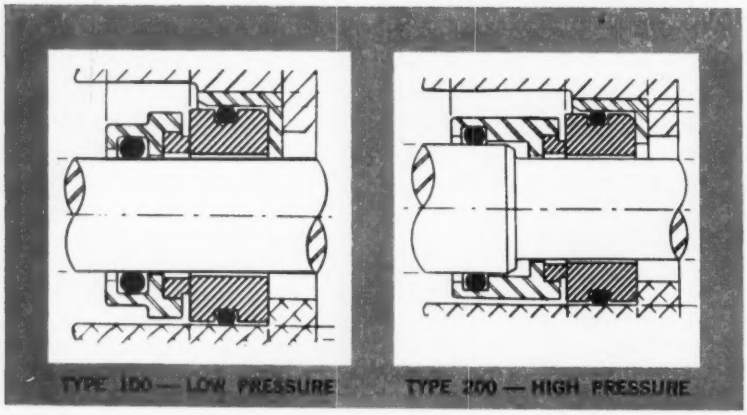

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Reports from the field

Begins on page 172

ing. So scientists built a system in which water flows at 500 gpm through copper windings of the magnet coils. A Patterson-Kelly Co, Inc, water chiller capable of supplying 100 tons of refrigeration per hr is at the heart of the system.

Calendar of Events

Mar 8-11—American Society of Mechanical Engineers, Gas Turbine Power Conference and Exhibit. Netherlands-Hilton Hotel, Cincinnati, Ohio. Details from ASME, 29 W 39th St, New York 18, N. Y.

Mar 9-13 — National Association of Manufacturers, 31st Institute on Industrial Relations. Hollywood Beach Hotel, Hollywood, Fla. Details: NAM, 2 E 48th St, New York 17, N. Y.

Mar 16-17—American Society of Mechanical Engineers, Lubrication Div: Spring Conference. Franklin Institute, Philadelphia, Pa. Details: ASME, 29 W 39th St, New York 18, N. Y.

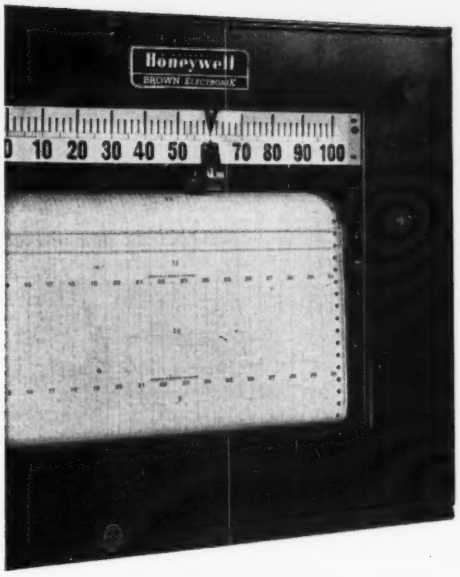
Mar 16-20—National Association of Corrosion Engineers, 15th Annual Conference and Corrosion Show, Sherman Hotel, Chicago, Ill. Details from NACE, 1061 M&M Bldg, Houston 2, Texas.

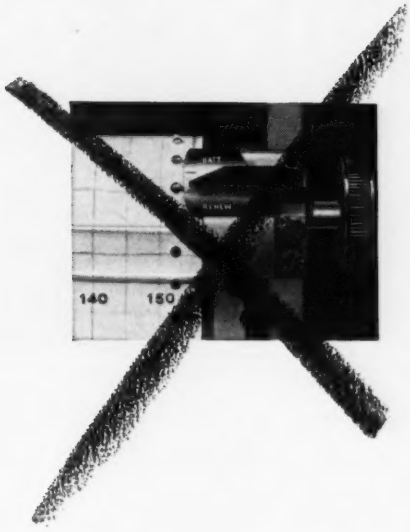
Mar 16-20 — American Society for Metals, 11th Western Metal Exposition and Congress. Ambassador Hotel, Los Angeles. Details: J Stratton, 7600 Beverly Blvd, Los Angeles 36, Calif.

Mar 17-18 — Manufacturing Chemists' Association, Air and Water Pollution Abatement Conference, Netherlands Hilton Hotel, Cincinnati, Ohio. Details: MCA, 1625 Eye St, NW, Washington 6, D.C.

Mar 29-Apr 2—American Society of Mechanical Engineers, Instruments & Regulators Div: Conference. Case Institute of Technology, Cleveland, Ohio. Details from ASME, 29 W 39th St, New York 18, N. Y.

Mar 31-Apr 2—Illinois Institute of Technology, American Power





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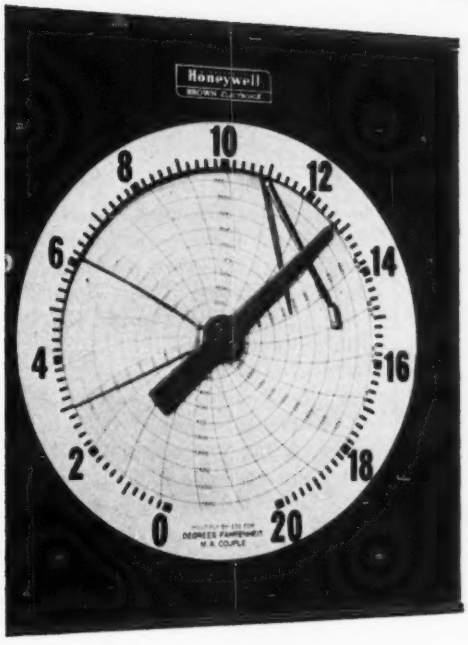

The new Honeywell Continuous Voltage Stabilizer makes batteries, standard cells, and standardizing mechanisms unnecessary in new Brown *ElectroniK* circular or strip chart potentiometers. This new unit accurately regulates the D-C reference voltage supply to the measuring circuit. Standardization is no longer necessary.

The small compact stabilizer unit uses Zener diodes and an ambient temperature compensator to deliver a constant rectified voltage from line supply. This enables the instrument to respond to changes in the measured variable without interruption.

Each Continuous Voltage Stabilizer means more dependability, less maintenance, continuous attention to the measured variable, and still another reason why *ElectroniK* instruments are your best value in measurement and control. Get complete details from your nearby Honeywell field engineer . . . he's as near as your phone.

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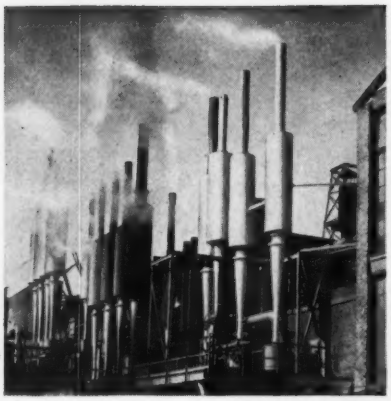
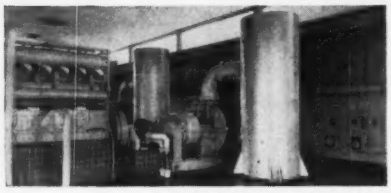


STEAM AIR EJECTORS



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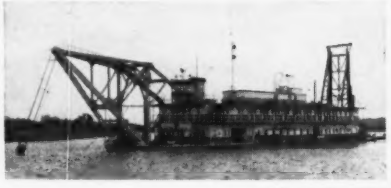
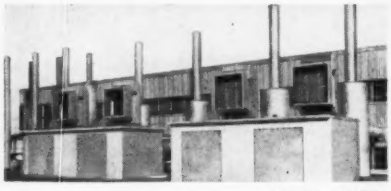


MARINE ENGINES



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address

Reports from the field

Begins on page 172

Conference. Hotel Sherman, Chicago. Details from R D Meade, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Ill.

Apr 2-5—Refrigeration Research Foundation, Conference. Statler and Mayflower Hotels, Washington, D.C. Details from RRF, 12 N Mead Ave, Colorado Springs, Colo.

Apr 5-9—Edison Electric Institute, Annual Convention. New Orleans, La. Details: EEI, 750 Third Ave, New York City, N. Y.

Apr 5-10—Engineers Joint Council, Nuclear Congress. Cleveland Auditorium, Cleveland, Ohio. Details from Dr S Baron, Burns & Roe, Inc, 160 W Broadway, New York 13, N. Y.

Apr 10-12—Wisconsin College of Engineering, Engineering Exposition. Details from U of Wisconsin, Madison 6, Wis.

Apr 14-15—Armour Research Foundation, Conference on Industrial Instrumentation and Control. Illinois Institute of Technology, Chicago. Details: M J Jans, ARF, 10 W 35th St, Chicago 16, Ill.

Apr 19-23—American Society of Mechanical Engineers, Oil & Gas Power Div, Conference and Exhibit. Shamrock - Hilton Hotel, Houston, Texas. Details from ASME, 29 W 39th St, New York 18, N. Y.

Apr 20-22—Instrument Society of America, Oak Ridge Section, Fifth Annual Southeastern Regional ISA Conference and Exhibit. Gatlinburg, Tenn. Details: J A Russell, 159 Athens Rd, Oak Ridge, Tenn.

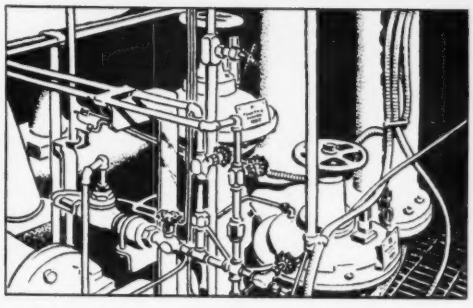
Apr 23-24—American Society of Mechanical Engineers and Society for the Advancement of Management, Management Conference. Statler-Hilton Hotel, New York. Details from ASME, 29 W 39th St, New York 18, N. Y.

Apr 29-May 4—Oil-Heat Institute of America, Inc, Annual Convention. Seattle, Washington. Details from OHI, 500 Fifth Ave, New York 36, N. Y.

continued

Where metal costs less than plain water

SALTY, SANDY WATER IN CIRCULATION PUMP GLAND SEALS AT A COASTAL POWER PLANT CUT SHAFT SLEEVE LIFE BELOW 2½ YRS. USE OF FRESH WATER IN PACKING GLANDS WOULD HAVE REDUCED ABRASION, CORROSION. BUT THERE WAS A CHEAPER WAY. "S" MONEL® HARD-GRADE NICKEL-COPPER ALLOY SLEEVES, PRODUCED AT INCO'S BAYONNE FOUNDRY, WERE INSTALLED. NOW IN SERVICE 4 YEARS ...NO REPLACEMENTS...THE COST OF "S" MONEL SLEEVES WAS LESS THAN THE ESTIMATED COST OF PROVIDING FRESH WATER FOR LUBRICATION.



"Free" samples...free from impurities at new ion exchange

IT TAKES A MAZE OF SMALL TUBES TO PICK UP SAMPLES OF TREATED WATER, CAUSTIC SODA, AND WATER RINSES FROM AN ANION EXCHANGER. BECAUSE OF A CONSTANT CORROSION PROBLEM CAUSED BY ACID REGENERATION, MONEL ALLOY IS USED FOR THE TUBES, FITTINGS, AND FIXTURES THROUGHOUT THE SAMPLING SYSTEM OF AN EASTERN POWER PLANT'S NEW ION EXCHANGE SYSTEM.

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PLUG'S SHAPE PREVENTS TUBE SHEET DAMAGE, MAKES CERTAIN PLUG IS DRIVEN IN CONCENTRIC WITH TUBE. OF MONEL* NICKEL-COPPER AND INCONEL* NICKEL-CHROMIUM ALLOYS, PLUGS ARE CORROSION-RESISTING AND GALVANICALLY COMPATIBLE WITH HEAT EXCHANGER TUBE MATERIAL.

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A TALK WITH ENGINEERS FROM INCO'S MECHANICAL ENGINEERING SECTION MAY HELP YOU GET BACK ON SCHEDULE. JUST GET IN TOUCH WITH US AND OUTLINE THE DETAILS. AND FOR A USEFUL RUN-DOWN ON MONEL ALLOY, WRITE DEPARTMENT **PE** FOR 30-PAGE INCO BULLETIN, "ENGINEERING PROPERTIES OF MONEL AND 'R' MONEL ALLOYS."

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"I have a problem..."

- ☐ scale, corrosion, or foaming in my boiler operation
- ☐ rust and corrosion in my steam and condensate return lines
- ☐ scale, corrosion, or algae growth in my cooling or condenser water system
- ☐ corrosion or scale in my potable or plant water supply lines and tanks
- ☐ rust and corrosion in my brine or sweet water system
- ☐ scaled up pumps, water jackets, compressors, coils, lines, or equipment
- ☐ sludge and moisture in my fuel oil supply
- ☐ soot deposits in my furnace combustion areas

"I'd like to know..."

. . . exactly what specific treatment your Technical Services Dept. recommends. I understand that such problems have been your specialty for over 65 years and that you have an outstanding record for restoring and maintaining efficiency of plant equipment through advanced chemical treatment. Will look forward to receiving in the near future both your latest technical literature *and* a personal letter concerning my problem. I understand that my inquiry involves no obligation.

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Mail to Technical Services Dept., WESTERN CHEMICAL CO.
713 Washington St., Kansas City 5, Mo.

Reports from the field

Begins on page 172

May 3-6 — Air-Conditioning and Refrigeration Institute, Board and Annual Meeting. The Homestead, Hot Springs, Va. Details from ARI, 1346 Connecticut Ave, N W, Washington 6, D.C.

May 4-5—American Society of Mechanical Engineers, Maintenance & Plant Engineering Div, Conference. Edgewater Beach Hotel, Chicago, Ill. Details from ASME, 29 W 39th St, New York 18, N. Y.

May 7—Armour Research Foundation, Symposium on Corrosion Inhibitors, Theory and Mechanism. Illinois Institute of Technology, Chicago. Details: M J Jans, ARF, 10 W 35th St, Chicago 16, Ill.

May 11-13 — American Institute of Electrical Engineers, Conference on Automation Techniques. Chicago, Ill. Details from AIEE, 33 W 39th St, New York 18, N. Y.

May 11-13—Instrument Society of America, National Power Instrumentation Symposium. Kansas City, Mo. Details from H H Johnson, Consolidated Edison Co of New York, 4 Irving Place, New York 3, N. Y.

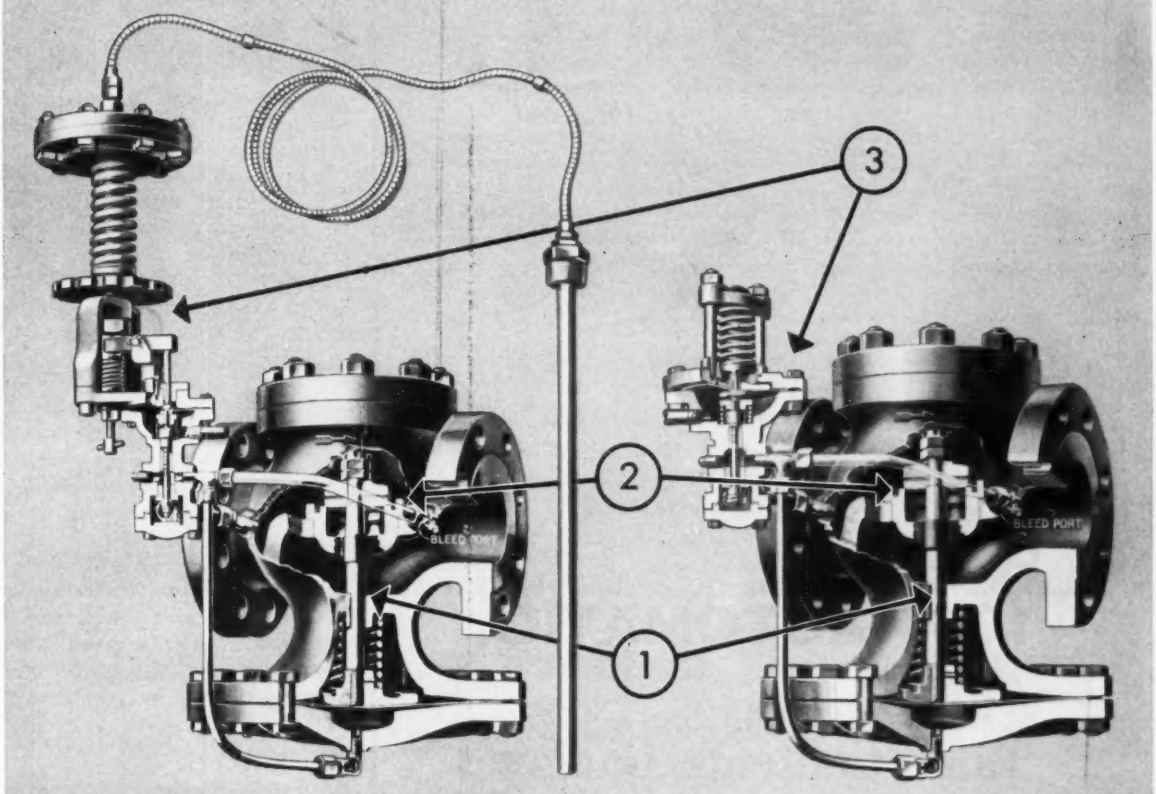
May 18-20 — Instrument Society of America, Fifth National Symposium on Instrumental Methods of Analysis. Shamrock - Hilton Hotel, Houston, Texas. Details from H S Kindler, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

May 25-27 — Instrument Society of America, National Telemetering Conference. Cosmopolitan Hotel, Denver, Colo. Details from R Schmidt, Avco Mfg Co, 201 Lowell St, Wilmington, Mass.

Oil and Gas Power meeting to feature Texas hospitality

Hard-hitting technical sessions, two unique inspection trips, and old-fashioned Texas hospitality will make the 31st annual Oil and Gas Power Conference at Houston's Shamrock-Hilton a magnet for engineers during the week of April 19th, 1959. Sponsored

3 Tips for Low Maintenance in Automatic Regulating Valves



Spence ET124 Temperature Regulator

Spence ED Pressure Regulator

No engineer has to be told that downtime of regulating valves is costly—and a nuisance.

Nowadays the men who keep these valves operating want to make sure they aren't stuck with a maintenance headache for the life of their valves. That's why we are outlining this simple check list which covers three important features which keep maintenance costs down.

1. Stuffing boxes are probably the number one time consumer in valve maintenance. No matter how you figure it, repacking stuffing boxes is costly.

That's one reason Spence uses a "balanced" diaphragm construction which eliminates stuffing boxes. Simple stem guiding and large metal diaphragm operation reduce sticking and binding to a minimum.

2. Another problem is replacement of seats and discs when they've been cut by steam. Today you can forget about this problem entirely by insisting on an unconditional guarantee against wiredrawing. Spence, for instance, uses SECO Metal seats and discs and gives such a guarantee.

3. Any valve designed to control temperature and pressure within tight limits can be affected by dirt in the steam lines. You can't get a guarantee against this, but you can specify a valve that makes trouble shooting easy. Here's the tip:

Make sure your regulating valve is controlled by an external pilot. If trouble develops, it is easy to find out if it is in the pilot or the main valve with a simple test.

If the trouble is in the pilot, you can remove it without taking the main valve out of the line.

The quickest way to get the regulator working again is to install a spare pilot. This is easy—and in the Spence design it is not expensive to carry spare pilots. Spence pilots fit all sizes of Spence main valves.

These maintenance advantages plus other advanced features are available in a wide range of Spence automatic regulating valves. For more information write for the Bulletin TE.

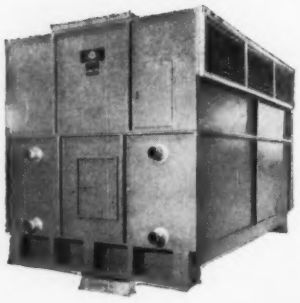
SPENCE ENGINEERING COMPANY, INC.
Walden, New York

SE-144

For more facts circle 313 on Reader Service Card, p 122

This Self-Contained Fluid Cooling System

. . . gives most accurate temperature control



Applied in cooling industrial machines or processes to temperatures approaching the ambient wet-bulb, the NIAGARA *Aero* HEAT EXCHANGER is independent of any more than a nominal water supply or disposal. The coolant system is a closed one, free from dirt and maintenance troubles.

Heat is removed from your process *at the rate of input,* giving you precisely the temperature you require and assuring the quality of your product. Heat may be added to prevent freezing in winter or for better control in a warm-up period. Liquids or gases are cooled with equal effectiveness.

Heat is rejected outdoors. Only the little water evaporated on the cooling coils in the air stream, or discharged to prevent hardness build-up, is consumed.

Niagara sectional construction saves you much installation and upkeep expense, gives full access to all interior parts and piping. Your equipment always gives you full capacity and "new plant" efficiency.

Write for Niagara Bulletin No. 132 for complete information

NIAGARA BLOWER COMPANY

Dept. P-3, 405 Lexington Ave., New York 17, N.Y.

District Engineers in Principal Cities of U. S. and Canada

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LONG ISLAND CITY 1, NEW YORK

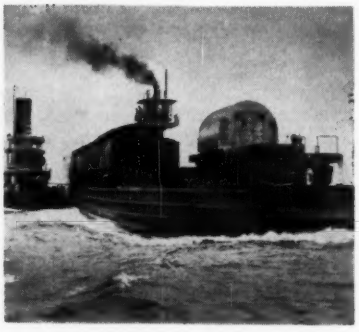
by the Oil and Gas Power Div of the American Society of Mechanical Engineers, the meeting includes as well an outstanding exhibit of internal-combustion equipment.

For early arrivals there will be a "get-acquainted" reception on Sunday afternoon, April 19th. Monday's technical sessions will deal with high-compression and supercharged gas engines, speed-governing specifications, standard practices and power costs. Monday evening will feature a special lecture on automation in the oil and gas industry.

A session Thursday morning will dig deeper into turbocharging. In the afternoon, two inspection trips will be available: a 130-mile circle tour including visits to three pipeline stations, and a tour of the port of Houston. A western party and barbecue will round out the day.

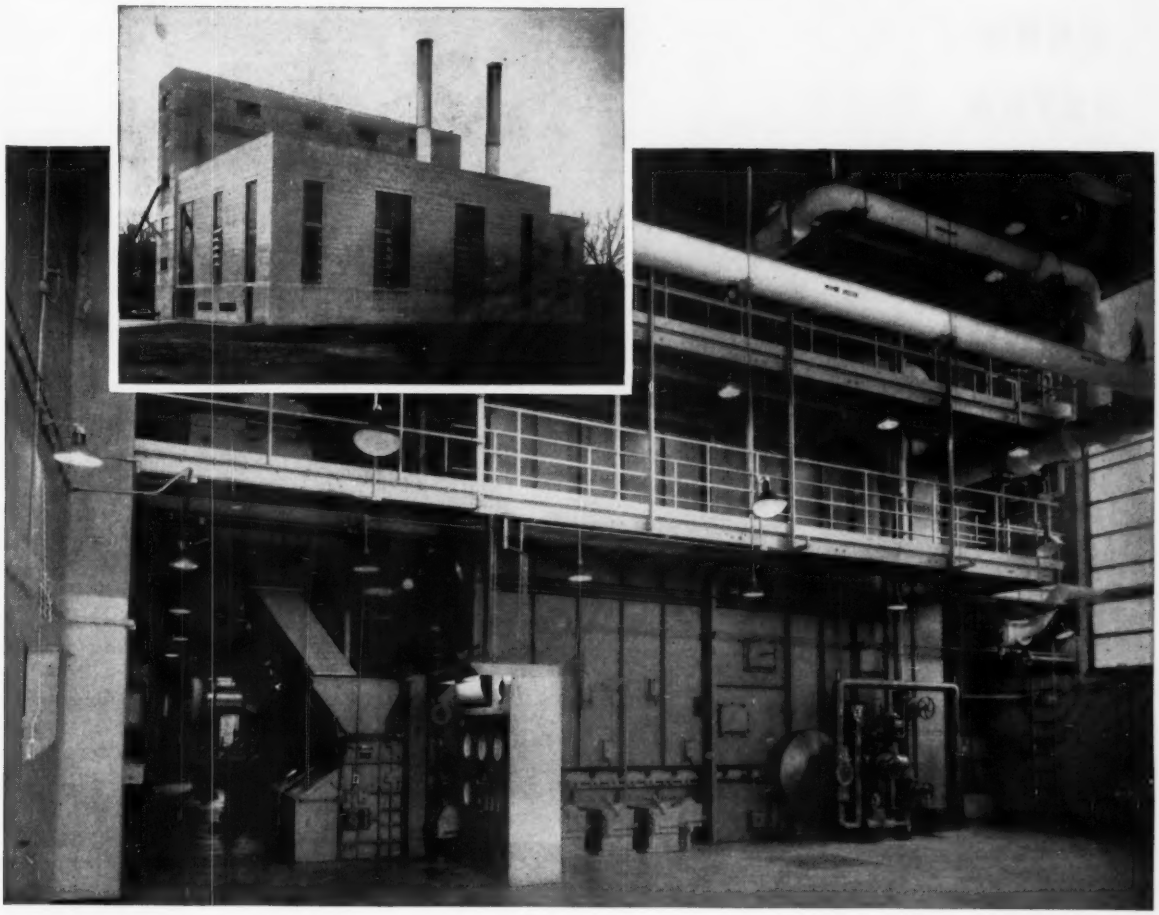
Wednesday's papers discuss several phases of lubrication and a panel will explore various aspects of engine foundations. The annual banquet will conclude the day: major speaker is Dr Harold Vagtborg, president of Southwest Research.

Technical sessions on Thursday, April 23rd, final day of the conference, will deal with a wide variety of subjects: cylinder corrosion, waste-heat utilization, rotary compressors, vibration isolation and construction contracts.



Intrepid sea-going stator makes ferry's heaviest load

Breasting the waves, above, is a 450,000-lb 220-mva supercharged generator stator, neatly packed on a 32-wheel 500,000-lb depressed-center railroad car aboard a ferry. The Allis Chalmers-built stator was heaviest



Union Boilers stretch fuel dollars at Mendota State Hospital

A dependable steam supply with low steam generating costs plays a key role in the efficient operation of the Mendota State Hospital. Occupying 384 acres near Madison, Wisconsin, it houses 900 patients and 491 employees in 40 buildings. To reach the furthest point of service, steam travels over half a mile from the power plant.

Carrying the load is a pair of Union 2-drum VO Type Steam Generators. Individually rated at 50,000 lbs./hr. at 165 psi, both units are fired with traveling grate stokers, and together, burn 12,000 tons of coal annually. Since the day this Union Boiler duo was installed, the hospital has enjoyed uninterrupted steam service.

At many institutions as well as industrial and public power plants, careful consideration of long term steam costs has been an important factor in the choice of Union boilers. Over 67 years of experience in steam generation stands behind their proven performance.

GET FULL DETAILS on how Union Steam Generators can stretch your fuel dollars. Available for oil or gas firing, they're built in many sizes and types to meet a wide range of steam requirements. Write for illustrated Catalog GB-153.

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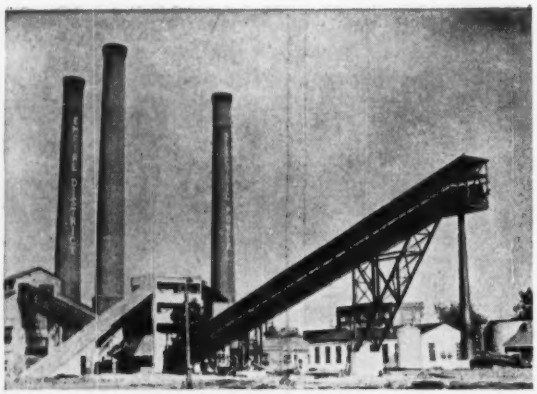
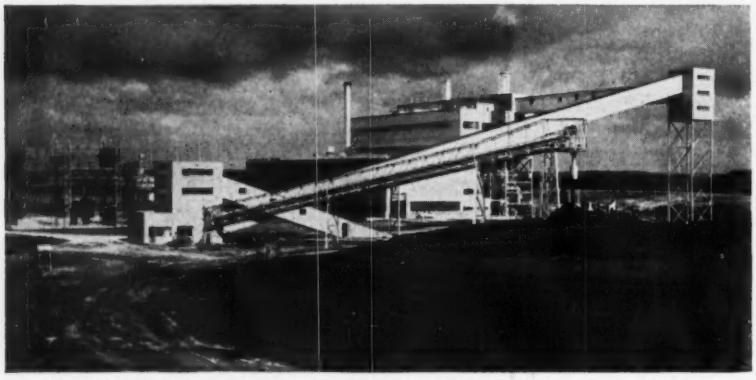


McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.



McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

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Name_____ Title_____

Company_____

City and State_____

Reports from the field

Begins on page 172

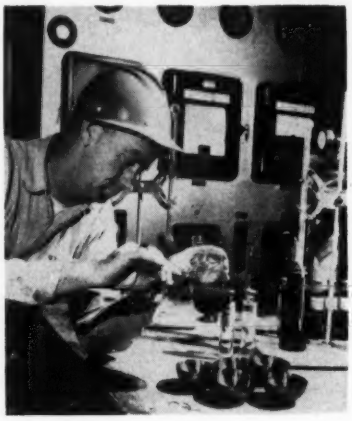
single carload ever carried across Hampton Roads, Va. After debarking, ensemble continued its trip by rail, to the Yorktown station of Virginia Electric Power Co.

Heat to electricity is topic of American Power Conference

Direct conversion of heat to electricity will be discussed at the 21st annual American Power Conference to be held at Chicago's Hotel Sherman March 31st through April 2nd.

J C R Kelly Jr, Westinghouse Research Lab, will describe present status and future prospects of direct conversion, while L J Linde, C Stellarator Associates, discusses thermonuclear fusion.

Topics to be covered at 26 sessions include electrical heating, nuclear power plants, hydro policies, E-H-V systems, fuels. The conference will be conducted with the cooperation of a group of educational institutions and technical societies. Director is R A Budenholzer of Illinois Institute of Technology.



Proper lube pays off at Deepwater Station

Lab man for Deepwater Power Station, Penns Grove, N. J., makes a periodic check on turbine oil. Some turbines have been in operation 17 years, but the Gulf oil is free of sludge and rust. The 227,000-kw station has five units, first of which started up in 1930. A sixth, 79,000-kw unit is currently being installed at the Deepwater Station.

the **WALWORTH CUSTOMER** *wants* **PLASTIC VALVES** *and* **FITTINGS** *that can't corrode ...here's how he gets them*

When the Walworth Customer is faced with the control of corrosive fluids, he looks at dozens of plastic valves and checks them for himself. He demands answers to questions like these: Can this valve corrode? Is it toxic? Is it non-aging? In Walworth PVC Valves and Fittings, the Walworth Customer finds his answers. Not only is PVC nontoxic and non-aging, – it *can't* corrode. *All* parts are made of plastic. Valves and fittings have high burst strength. Given those facts the Walworth Customer buys.

That may be the way you like to buy valves, too. If you insist on knowing about materials, workmanship and high quality, we'd like you for a Walworth Customer, too. For the newest literature on the complete line of PVC Valves and Fittings, get in touch with your Walworth Distributor.

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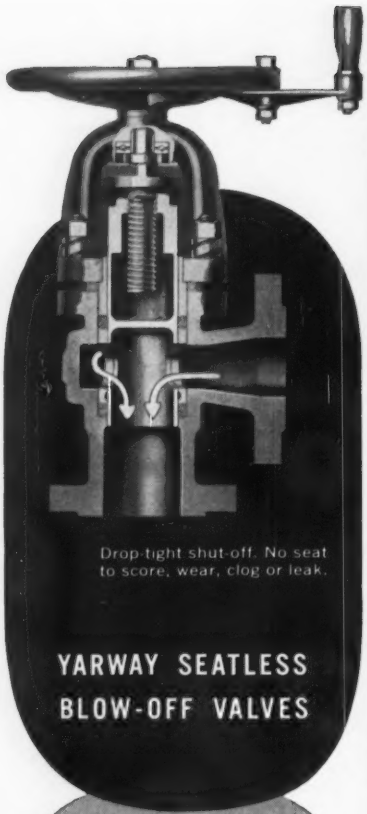

the lowdown on blowdown

Over 16,000 boiler plants depend on Yarway Seatless Blow-Off Valves. Pressures to 600 psi. Single or tandem combinations. For free Blow-Off Valve Book write YARNALL-WARING CO., 100 Mermaid Ave., Philadelphia 18, Pa.

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Appointments

Corporation changes

The Garlock Packing Company: R M Waples, board chairman; A J McMullen, president. **Niagara Blower Company:** P H Schoepflin, board chairman; M H Olstad, president. **Thermix Corporation:** L C Whiton, board chairman; J T Doyle, president.

Sperry Products, Inc: F U Hayes, president and general manager. **Air Reduction Sales Company:** R E Lenhard, president; Dr Albert Muller, vice-president. **H K Porter Company, Inc,** Delta-Star Electric Div: S C Killian, vice-president and general manager. **The Petersen Engineering Co, Inc:** J T Isbell, vice-president.

Sylvania-Corning Nuclear Corporation: L A Carapella, vice-president. **Cornell - Dubilier Electric Corporation:** R T Leary, vice-president. **Bechtel Corporation:** R A Bowman, vice - president. **Westinghouse Electric Corporation:** H S Kaltenborn, vice-president and assistant to president; Dr S W Herwald, vice-president in charge of research. **American Chain & Cable Company, Inc:** W F Wheeler Jr, executive vice-president.

Cooper Alloy Corporation: D R Hepler, vice-president of manufacturing. **Moloney Electric Company:** J M Dohr, production vice-president. **Edison Electric Institute,** Committee on Atomic Power: J J Kearney, staff assistant, secretary.

Operations changes

General Electric Company: C W Elston, general manager, gas-turbine dept; M I Alimansky, manager of distribution-transformer dept, high-voltage specialty transformer product section. **Gates Rubber Company,** Nashville plant: D L Peterson, general manager; C W Gish, technical superintendent.

Hagan Chemicals & Controls, Inc, Controls Div: J E Duesing, general manager; Chemical Research and Development Dept: E A Yorkgitis, group leader. **Arcrods Corporation:** Dr G E Claussen, director of research and welding engineering. **American - Standard,** Detroit Con-

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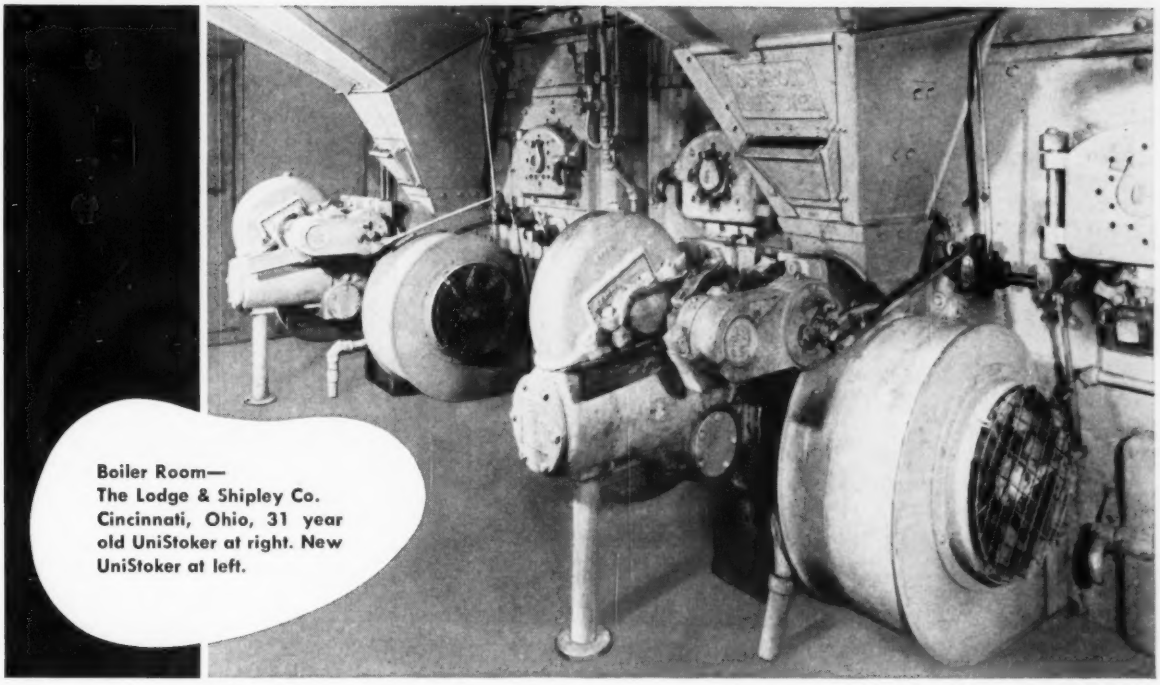
UNI-STOKERS NEVER DIE, NEVER DIE

THEY JUST GO ON... AND ON*

31 Year old Detroit UniStoker is still serving and saving



Boiler Room—
The Lodge & Shipley Co.
Cincinnati, Ohio, 31 year old UniStoker at right. New UniStoker at left.

● A Detroit UniStoker installed at The Lodge & Shipley Co., Cincinnati in 1927 performed so well and proved the economy of UniStoker firing so conclusively that another UniStoker was purchased in 1958 when added steam capacity was needed to serve plant expansion.

EVEN MORE SIGNIFICANT—the original UniStoker after 31 years of service was doing such a good job it was deemed worthy of modernization.

Some of the up-to-date UniStoker features were added to it and many more years of efficient operation are expected.

As the song says—"They just go on and on", saving as they go.

YOU can save with Detroit Stokers. Let one of our sales Engineers recommend the correct stoker for your needs.

The Complete Detroit Line of Underfeed and Overthrow Spreader Stokers provides a type and size for almost any boiler from 3,000 to 400,000 pounds of steam per hour capacity.

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For additional data consult Chemical Engineering Catalog pp. 1035-1038

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Appointments

Begins on page 186

trols Div: G F Butterfield, general manager, manufacturing; J S Amneus, manager of research and advanced development; R L Campbell, director of engineering.

General Controls Co: H E Shane, industrial systems manager. **Leslie Co:** J T Muller, manager of research and development. **H K Porter Company, Inc,** Forge and Fittings Div: D R Miller, works manager of W-S Stainless Steel Works. **Chase Brass & Copper Co,** Chase Metal Works: H F O'Shaughnessy, works manager. **The Bunting Brass and Bronze Company:** Dr R A Schaefer, director of research and development dept.

Consultant changes

Roy F Weston, Inc, Consulting Div: V T Stack Jr, director. **Fuel Engineering Company, Inc:** Paul Mulcey, Allen Johnson, associates.

Worthington Corporation, Harrison div: I J Karassik, consulting engineer and manager of planning. **General Electric Company,** Lamp Div: D L Millham, consultant.

Engineer changes

The H K Ferguson Company: R B Aufmuth, chief engineer. **California State Polytechnic College:** L F Osteyee, head of mechanical engineering dept.

Tuthill Pump Company: E H Schanzlin, chief engineer. **Leslie Co:** A W Richart, chief of product engineering. **Air-Maze Corp:** Ned Lamprecht, chief application engineer.

General sales manager

Walworth Company: Harold Brown. **Keasbey & Mattison Company,** Sales Div: N L Barr. **Dresser Industries, Inc,** Roots-Connersville Blower Div: G H Crocker.

Koppers Company, Inc, Metal Products Div: T F Naylor. **H K Porter Company, Inc,** Delta-Star Electric Div, Thomas Works: J F Zboyovsky, manager; W C Carpenter, assistant to the manager.

McGraw-Edison Company, Pennsylvania Transformer Div: T S Banghart, manager of switchgear sales; H D Tindall, manager of small power-transformer sales. **Carrier**

Still ANOTHER Cottrell Advancement By Western Precipitation...

UNIQUE "FULL-RANGE" RAPPER CONTROL PROVIDES ENTIRELY NEW STANDARDS OF VERSATILITY

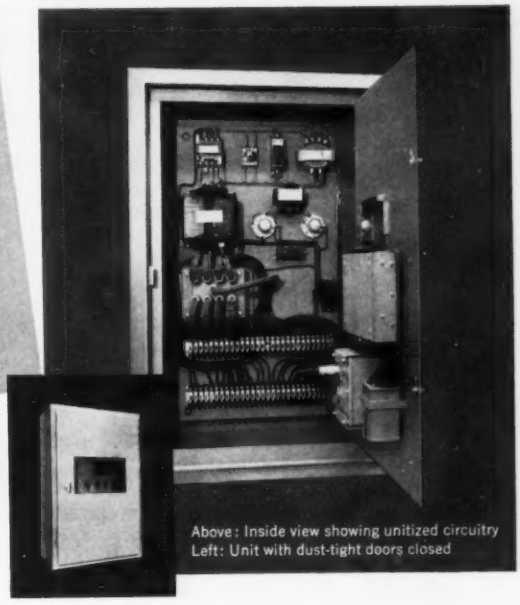
Rapping Frequency... Rapping Intensity... Rapping Pattern
ALL EASILY ADJUSTABLE TO MEET OPERATING REQUIREMENTS

THE PROBLEM:

In the operation of Cottrell Precipitators it is necessary to remove the dust, fume or fly ash that has collected on the plates and cause it to be deposited in a hopper for subsequent removal from the Precipitator. The Rapping System should accomplish this removal with minimum disturbance to the already collected material (to avoid re-entrainment) and with maximum cleaning of the plates.

However, collected materials vary widely in their physical characteristics. Some are sticky. Some agglomerate readily and in thick layers without disrupting electrical operation. Still others have no tendency whatever to agglomerate, but form a sheet of loose particles on the plate.

There is no "typical" dust—no fixed set of conditions to be met. **Yet the Rapper System must be readily adaptable to efficient dust removal, regardless of dust characteristics!**



Above: Inside view showing unitized circuitry
Left: Unit with dust-tight doors closed

THE SOLUTION:

With so many variables to be compensated, unusually wide adjustability of the Rapper System has long been a prime objective for optimum operating efficiency. But complex factors have prevented its attainment until development of Western Precipitation's new "Full Range" Rapper Control.

By simply adjusting a few dials, "Full Range" Control permits:

- **FULL FREQUENCY ADJUSTMENT** from a complete rapping cycle every 50 seconds to one every 3½ hours... or any desired cycle in between!
- **FULL INTENSITY ADJUSTMENT** from zero to maximum over an unusually wide range!
- **FULL PATTERN ADJUSTMENT** 2, 4 or 8 impacts per cycle can be selected, with each cycle varying from light to heavy on successive impacts within the cycle—all automatically controlled to a choice of pre-selected operating limits!

Other Important Advantages...

Greater Safety: The "Full Range" Control has no dangerous high voltage circuits to endanger personnel. Entire unit is in "low-voltage" category.

All "Passive" Design: There are no motors, gears, or other high maintenance components in the "Full Range" Control. It is completely electronic.

Space-Saving Compactness: The "Full Range" Control requires about *half* the space of previous designs. Also is water and dust tight—can be located virtually anywhere.

Unitized Circuitry: All related parts are unitized into separate "cans" for simplified maintenance.

Free! NEW BROCHURE which describes and illustrates the new "Full Range" Rapper Control—the latest product of Western Precipitation's program of continuous advancement!

A-M-101

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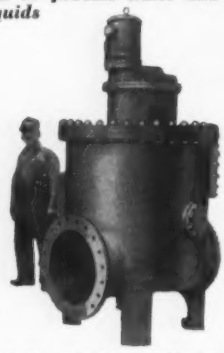
... for efficient removal and disposal of suspended particles from raw or process water and other liquids



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THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

Appointments

Begins on page 186

Corporation, Unitary Equipment Div: B T Kehoe, packaged air-conditioning equipment sales manager. **The Carpenter Steel Co:** T D Burley, manager of high-temperature steel sales; Barclay Morrison, assistant marketing manager.

District sales manager

Riley Stoker Corporation: G C Vail, Philadelphia. **Link-Belt Company:** E L Mills, Duluth. **American Air Filter Co, Inc:** J J Willis, midwest; A B Ullrich Jr, southern region. **Burroughs Corporation,** Electro-Data Div: W H Stewart, Philadelphia.

Macwhyte Wire Rope Company: W J Anderson, eastern and midwest regions. **Koppers Company, Inc,** Metal Products Div: J W Freund, central district.

Van-Packer Co: C M Montgomery, eastern; W C Henson, western district. **Allis-Chalmers Manufacturing Company:** R H Porterfield, New York industrial sales; W T Farnsworth, Hartford, Conn. district; S B Lamica, Jacksonville, Fla.

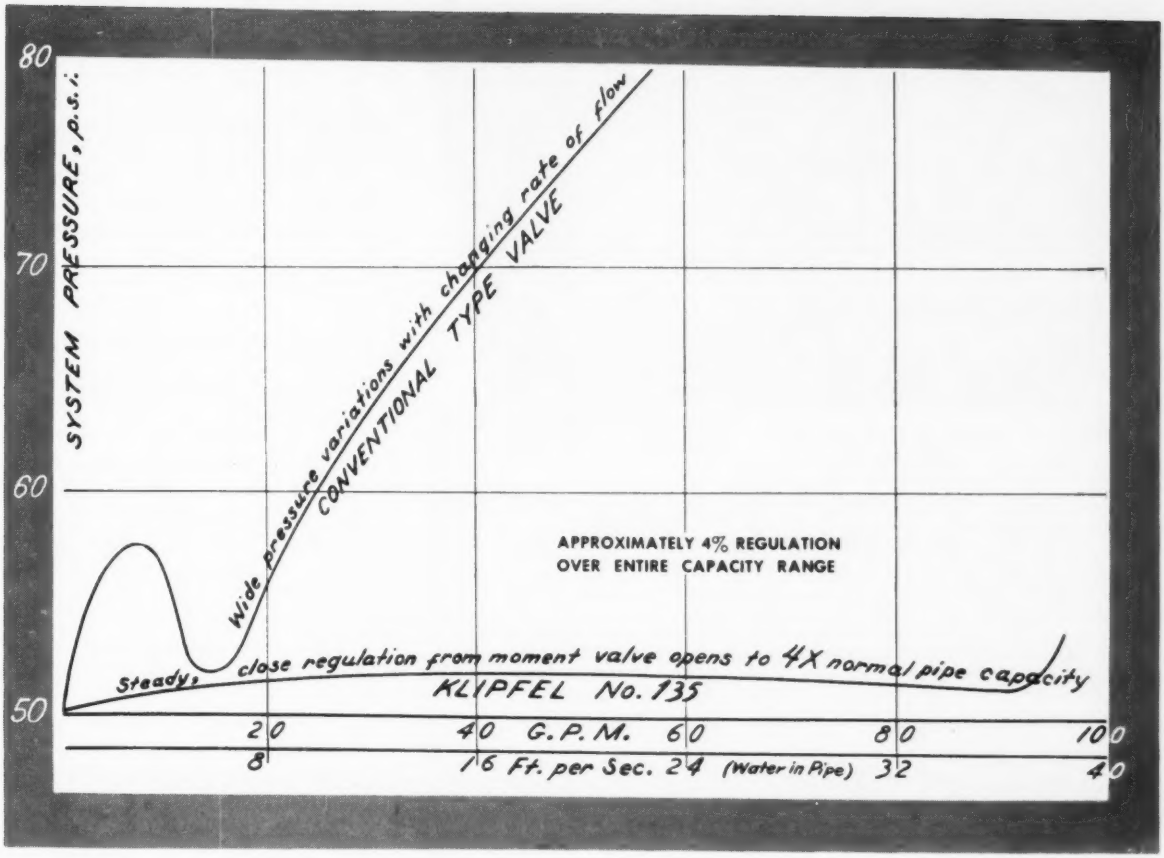
United States Steel Corporation: L W Mason, eastern; J G Morrison, central area. **H K Porter Company, Inc,** Delta-Star Electric Div: W E Erbe, Pittsburgh. **Fischer & Porter Co:** Dib Carpenter, western region.

New names

Westinghouse Electric Corporation: new power control and communications department within East Pittsburgh div. **American-Standard:** new Industrial Div, from consolidation of American Blower, Kewanee Boiler and Ross Heat Exchanger Div. **David M Schoenfeld:** consulting engineering practice at Mariomi Rd, New Canaan, Conn.

Millard D Shriver Company, Inc, 3025 W Mission Rd, Alhambra, Calif: sales and engineering firm specializing in instrumentation, control work. **Van Dorn Iron Works Co:** new Infra Red Div. **Almetco, Inc:** new company to produce aluminum extrusions for Olin Mathieson Chemical Corporation, **Textron, Inc.**

Houston Instrument Corporation, 1717 Clay Ave, Houston 3, Texas: new company for development,



If you need

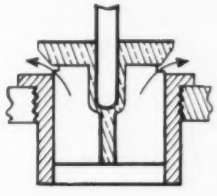
CLOSER REGULATION

and higher capacity, too...then you need

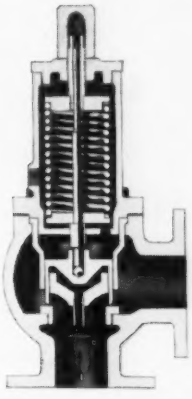
KLIPFEL #135 BACK PRESSURE VALVES

In this comparison test with a Klipfel No. 135 Back Pressure Valve, results showed only a 4% pressure variation over the entire capacity range, as against 50% with a conventional relief valve! Capacity is four times the normal capacity of a pipe of the same size. And, because of Klipfel's dash-pot design, you get smooth, chatter-proof opening.

CUP DESIGN MAKES THE DIFFERENCE! In conventional flat disc valves (left), effective disc area decreases rapidly as the valve opens because fluid pressure drops as you approach the outer edge of the valve. This means that inlet pressure rises appreciably as flow increases because as the valve opens, a higher inlet pressure is needed to compensate for the decreased area.



CONVENTIONAL VALVE



KLIPFEL #135 VALVE

With Klipfel's No. 135 Back Pressure Valve, however, pressure is transmitted to the space within the cup and is confined there (see right). The pressure is uniformly effective over the entire head of the disc, regardless of the valve opening. These valves are ideal for original equipment installations when fluid is clean and pressures are between 5 and 300 psi.

FREE: 14-page Bulletin 454, with charts, graph, tables and complete descriptions of Klipfel's Back Pressure Valves. For a complimentary copy, write on your letterhead.

HAMILTON • OHIO **Klipfel** VALVES, INC.

A DIVISION OF THE HAMILTON-THOMAS CORPORATION

Automatic Temperature-and-Pressure-Regulating Valves Since 1902

Float Valves • Temperature Regulators • Back Pressure Valves • Reducing Valves

Highest Quality Water Filtration in large volume with SPARKLER DIATOMITE FILTERS!

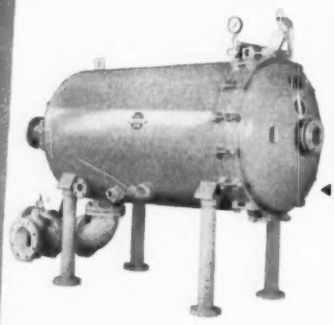
ALOYSIUS C. KRACKLAUER
Originator of the
Large Volume Diatomite Filter

Diatomite filtration of water in large volume is a comparatively recent development by Sparkler engineers. For many years the distinct superiority of diatomite filters in producing filtered water of highest clarity, with reduced bacteria count and with absolute uniform quality has been recognized by engineers in the chemical and other industrial fields, but old style diatomite filters were limited in volume.

Now the new large volume diatomite filters engineered by Sparkler have been tested in hundreds of successful installations in many industries and for municipal water supply, and have almost completely replaced sand filters for swimming pool filtration in schools, clubs, and municipal pools because of the greatly reduced chemical treatment necessary, to produce safe water.

This new phase of water filtration is worthy of careful investigation and study by all consulting engineers who are engaged in large volume water filtration.

MODEL RJ



A closed tank, pressure filter, with self cleaning features. The spent diatomite cake is peeled off the plates with the exclusive Sparkler Hydro-Scraper knife edge pressure spray and is washed out of the tank through the sloping bottom drain. The complete cleaning operation including precoating and recirculating for clarity ready for resuming operation is less than 30 minutes; a completely new uncontaminated filter media is thus provided. Filter element and spray tubes have no metal to metal contact with tank, thus providing electrolytic protection. Fully automatic electronic operation can be furnished.

Capacities are available in a single unit for 1,500,000 gal. per 24 hr. operation.

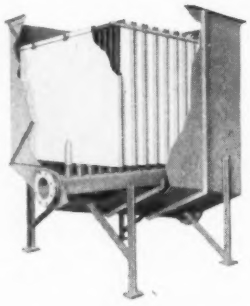
Approximately ¼ the floor space is required by this filter as compared with a sand filter and the installed cost is ⅓ to ⅔ that of sand.

MODEL HCV

A vacuum type filter that operates with an open tank and with full visibility of filtering process at all times. Plates are plugged into a self sealing outlet manifold at the bottom of the tank. Cake is removed by flushing off with hose. Spent cake flows out the self draining bottom through a T on the inlet supply pipe. Filter elements have no metal to metal contact with tank, thus eliminating electrolytic action.

This filter is available in capacities up to 900,000 gal. per 24 hr. operation.

Both filters have synthetic cloth covered plates that are removable without bolts or fastenings.



Write for bulletins and engineering data on these filters.

SPARKLER FILTERS

SPARKLER MANUFACTURING CO.
MUNDELEIN, ILLINOIS U.S.A.
Sparkler International Ltd., Manufacturing Plants at Leliegracht 9, Amsterdam, Holland; Toronto, Ontario, Canada; Italy and Australia

FILTRATION ENGINEERING & MANUFACTURING EXCLUSIVELY FOR OVER 30 YEARS

Appointments

Begins on page 186

manufacture and sale of specialized instruments. **Jeta, Inc:** new name of Jeta Metal Fabricators, Inc. **Whitehead Metals, Inc:** name change for Whitehead Metal Products Company, Inc. **Arthur V Peterson Associates,** Westport, Conn.: new firm for atomic energy consultation to management.

Recent purchases, mergers

Metals & Controls Corporation: plans to merge into Texas Instruments, Inc. **Rome Cable Corporation** and **Aluminum Company of America:** plan to affiliate, combine electrical conductor activities in a new Rome Cable Company. **Allis-Chalmers Manufacturing Company:** plans to acquire assets of S Morgan Smith Company.

Yuba Consolidated Industries, Inc: purchase of Southwest Welding and Manufacturing Company. **Kennecott Wire and Cable Company:** will become an operating division of The Okonite Company, subsidiary of Kennecott Copper Corporation.

Hoover Ball and Bearing Co: plans to acquire Strom Steel Ball Co and Coolidge Corp.

Retirements

C W Hedberg, president of Research-Cottrell, Inc, after 35 years of service.

C H Waddington Sr, model technician for Baldwin - Lima - Hamilton Corporation, after 39 years of service.

Obituaries

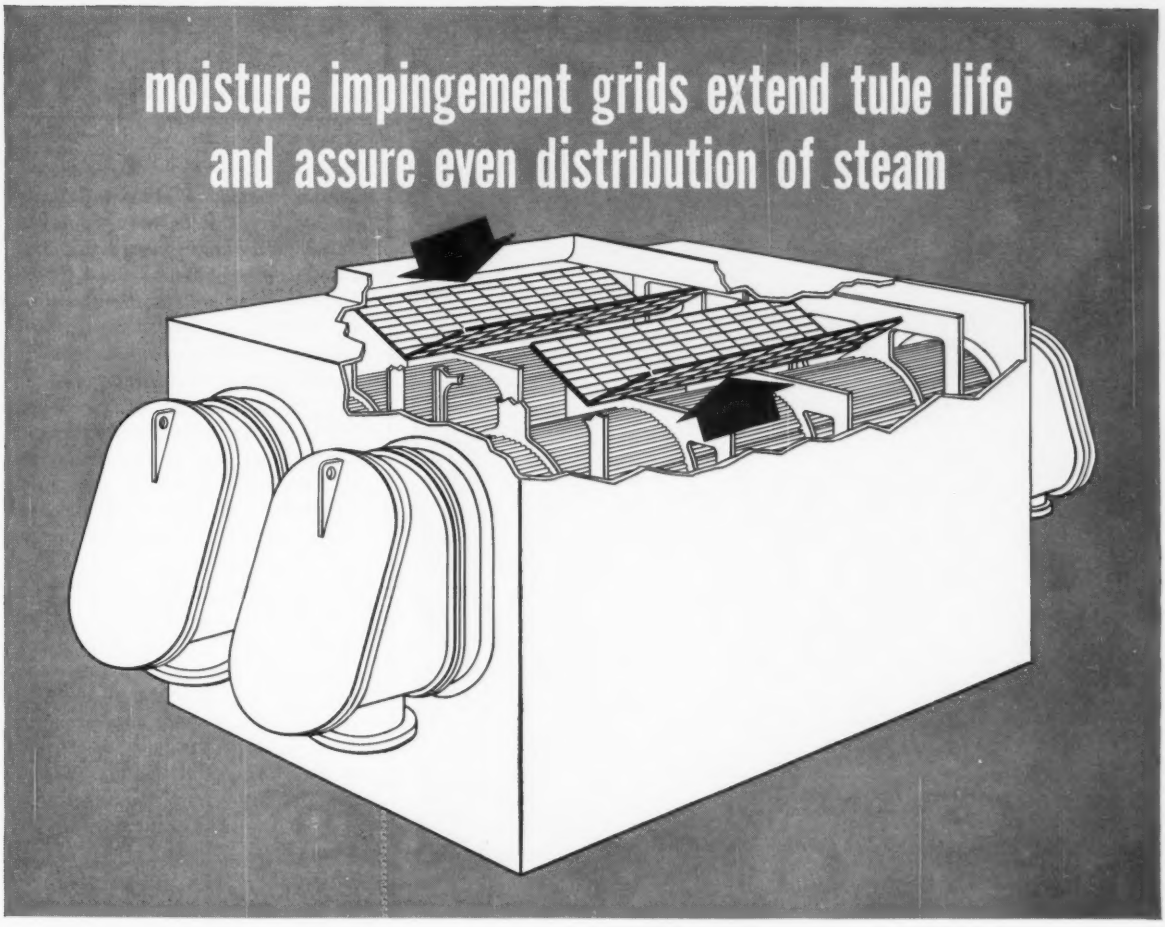
Joseph Kildare, senior vice-president in charge of sales for Yarnall-Waring Company, on Jan 8th. Mr Kildare had served his company for 44 years, advancing from a clerical capacity. He had retired on Jan 31st, 1958.

Louis W Olson, vice-president and director of The Ohio Brass Company, on Dec 15th.

Donald S Black, director of The Ohio Brass Company and manager of its Graybar Sales Div, on Dec 19th.

Verne E Minich, 91, founder of Wheelabrator Corporation, on Dec 13th.

Charles S Redding, board chairman and former president of Leeds & Northrup Company, on Jan 2nd.



Another Distinguishing Feature of

ROSS SURFACE CONDENSERS

Not one tube failure from impingement reported in 23 years! That's the record of Ross Surface Condensers since the first moisture impingement grids were installed in 1936. Today they are standard Ross equipment.

Just how important are they? Without them, high velocity, wet steam coming from the last wheels of the steam turbine often seriously shortens tube life . . . from impingement erosion or vibration wear at the support plates.

But the grids accomplish even more than that. Actually they perform two essential functions: (1) Because of the angle at which the grids are set, any moisture particle in the steam strikes a rib and loses its damaging velocity before entering the tube bank. (2) They act as turning vanes, controlling distribution of the steam around the tube bank.

No surface condenser can match the engineering that goes into the Ross design. Make sure you are current with its numerous advantages. Talk it over with a representative at your convenience and write for Bulletin 8.2K1 now.

American-Standard* Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto 4, Ont.

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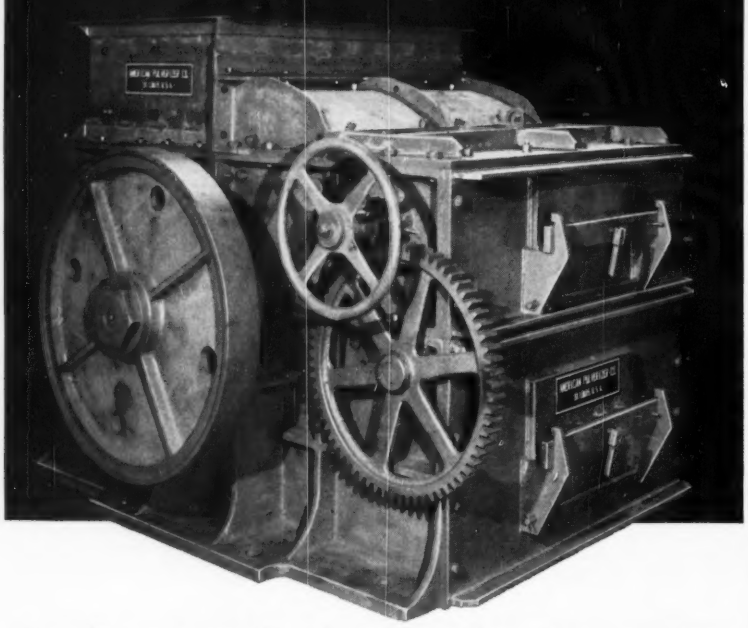
American Coal Crushers are RUGGED!



Soundly engineered and constructed to give you many years of high volume crushing at low operating costs.

1. Oversize bearings.
2. Alloy Steel heat treated rotor shaft.
3. Heavy rib reinforced housing with renewable liners and tramp metal pocket.
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8. Maximum flexibility of rolling ring rotor prevents injury from tramp iron.
9. Full width screening area gives faster discharge of reduced product.

Coal Crushers exclusively, from Sample Crushers to Capacities of 800 TPH
Write for literature stating capacity you need.

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Engineers'

Fundamentals of Thermodynamics. *By Carroll M Leonard, Professor of Mechanical Engineering, Oklahoma State University. 376 pp, illust, tables, 6¼ x 9¼, cloth, $8.00. Prentice-Hall, Inc, 70 Fifth Ave, New York 11, N. Y.*

A text for beginning students in thermodynamics that largely uses algebra in its mathematical treatment. Chapter headings indicate its scope: System, First law, Second law, Pure substance—steam, Vapor power cycles, Vapor refrigeration cycles, Perfect-gas system, Gas compression cycles, Gas power cycles, Gas and gas-vapor mixtures, Steady flow of fluids, Flow through pipes and ducts, Heat transfer.

The author uses worked-out examples for demonstrating application of principles and supplies an average of 45 problems per chapter for student exercises. The book features a separate Mollier chart carried in a pocket and printed in three colors for easy reading.

Marks' Mechanical Engineers' Handbook (1958). *Edited by Theodore Baumeister, Stevens Professor of Mechanical Engineering, Columbia University. Sixth Edition, 2320 pp, illust, tables, 6½ x 9¼, cloth, $23.50. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y.*

This famous handbook has been completely revised and modernized as well as improved in treatment in some departments. More than 100 contributing engineers and scientists have participated in preparing the 18 major sections. As in all handbooks, the level of presentation assumes the reader has had a basic grounding in the elements of engineering.

The major topics range over the entire field of mechanical engineering, many of them of prime importance to the power-service engineer. These include: air conditioning, atomic power, bearings, building construction, compressors, fans, blowers, corrosion, electrical engineering, friction, fuels and furnaces, gas turbines, heat transmission, heating and ventilation, hoisting and conveying, hydraulic turbines, illumination, industrial engineering, instruments and

Bookshelf

controls, internal-combustion engines, iron and steel, lubrication, machine elements, machine-shop practice, materials, mechanics of fluids and solids, piping, pumps, refrigeration, steam power, thermodynamics, vibration and welding.

This handbook will help the power engineer to keep abreast of modern developments and latest theory. An 86-page index helps to find material quickly. Cross references within the book broaden the scope of treatment and references tell where to find additional information.

Steam Turbine Performance and Economics. *By Robert L Bartlett, General Electric Co, with contributions by J E Mulder and R C Sheldon, General Electric Co. 317 pp, illust, tables, cloth, 6¼ x 9¼, $12.50. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y.*

The power-plant designer's task becomes more and more involved as the range of equipment available grows. To make sure he has chosen the best combination he must examine a variety of machines and their performance in combination. After he has done this, he must make an economic comparison as one important element in making a final choice.

This book helps the designer in his problems by showing how to compute performance for a variety of steam conditions, capacities and turbine arrangements. This type of information had been made available at intervals by formal papers published by the ASME, but design improvements made much of this information obsolete.

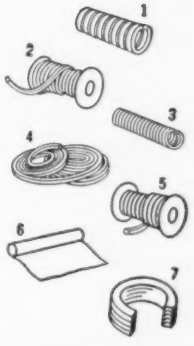
The Bartlett book brings the basic turbine-performance information up to date and details the manner in which it must be used. The chapter headings show the scope: Thermodynamics of turbine performance, Turbine heat balance, Turbine efficiency, Effect of steam conditions, Feedwater heating cycle, Estimating techniques, Gas turbines and combined cycles, Economic evaluation, Considerations in equipment costs, Cost of steam power plants, Operating and investment costs.

A mechanical packing problem . . .

HOW AN R/M DISTRIBUTOR PUT AN END TO A DAIRY COMPANY'S TOUGH BOTTLE WASHER PROBLEM

A prominent dairy company once used ordinary braided packings on its bottle washing machines, but they brought a lot of trouble, coming apart because of the solvents, chlorine and detergents used. On the advice of an R/M distributor, the company tried No. 1845 "Versi-Pak,"® one of the R/M Big 7 packings. This entirely solved the problem. Bottling machines are now repacked two or three times a year where previously it was necessary to repack weekly.

You can enjoy the same kind of sure, economical results by getting in touch with your nearby R/M packing distributor. Not only will he help you reduce your packing inventory, but he will show you how the Big 7 plan makes ordering easier, makes delivery faster. Write for his name and address today.



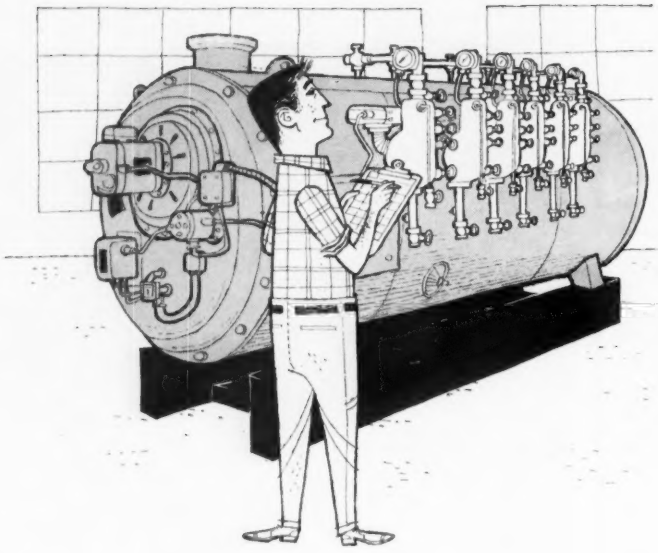
THE BIG 7 PACKING TYPES

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

BIG 7 PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings Brake Blocks • Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

For more facts circle 330 on Reader Service Card, p 122



George Edwards

asks, "How much is 6 X 0?"

I recently saw a little piece in a boiler-insurance company publication entitled, "Prevent damage to packaged boilers." Among other things it pointed up importance of dependable feedwater pumps and low-water safety controls. Then it said, "*If unattended for more than one hour, packaged boilers should be fitted with a second low-water cutoff as a second line of defense.*" (Italics are mine.)

There's quite a story behind this recommendation, and it's one of sheer bubble-headed maintenance of what is perhaps, second to the safety valve, the most important safety device on a packaged boiler. Insurance companies, for more years than they care to remember, have paid through the nose for damage due to low water, though the boiler in each case was equipped with a cutoff. Investigation invariably showed that had the cutoff been properly maintained there'd have been no failure to function—and no damage to the boiler.

Many boilers have been operating for years with one cutoff. They haven't had any low-water difficulties and I dare say they've often been left unattended for an hour or so. Difference between these plants and those having trouble is *maintenance.*

Reputable cutoffs today are ruggedly built and engineered to do a job. They do it, too, if given half a chance. Insurance companies recommending a second cutoff aren't saying that one won't do the job. What they are saying, in effect, is that, even with lousy maintenance, there isn't too much chance of both cutoffs giving up the ghost at the same time. We could carry this thinking a little further and say why not a third to back up the second, and a fourth to back up the third, and so on. We'd cut chances of low-water damage to next to nothing.

This thinking advises treating effects rather than causes, which is a bum way to cure anything. Insurance people I've talked with are against it in principle, but they're up against causes they can't control. So they're taking the only road left.

To low-water cutoff manufacturers this would seem an ideal situation. They'd be in a position to practically double sales without lifting a finger—particularly if this recommendation should ever become a part of existing boiler laws across the country. I haven't talked with any of them, but I suspect they'd rather have one control per boiler and have it get proper care. It's just possible that, if one must be backed up by a second, people might wonder if the control is as good as it's cracked up to be.

If this second low-water cutoff recommendation becomes standard procedure, it may cut low-water damage for a while. But sooner or later, lousy maintenance will catch up with both units and protection against low-water damage will return to zero. No matter how you figure it, 2×0, or 6×0, is zero.

FOR MOVING HEAT TRANSFER LIQUIDS...

RELY ON "BUFFALO" HIGH TEMPERATURE PUMPS

These pumps are designed especially for handling high temperature liquids. The following description will help you evaluate the suitability of these pumps for this specialized service.

In addition to these special features, "Buffalo" High Temperature Pumps bring you the famous "Buffalo" hydraulically efficient impeller and casing design. Accessibility, dependability and long, maintenance-free life are important *extra* values in every "Buffalo" Pump.

Whatever your heat transfer problem — including vapor phase — phone your "Buffalo" engineering representative for full information.

Only "Buffalo" Pumps bring you the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

BUFFALO PUMPS

Division of Buffalo Forge Co.

488 Broadway, Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

"Buffalo" PUMPS

SPECIAL FEATURES "BUFFALO" HEAT TRANSFER PUMPS

Cast Steel Casings and Sides with Full Centerline Support.

Water Cooled Bearings and Stuffing Boxes

Special Packing, Mechanical Seals are Available.

Smothering Gland.

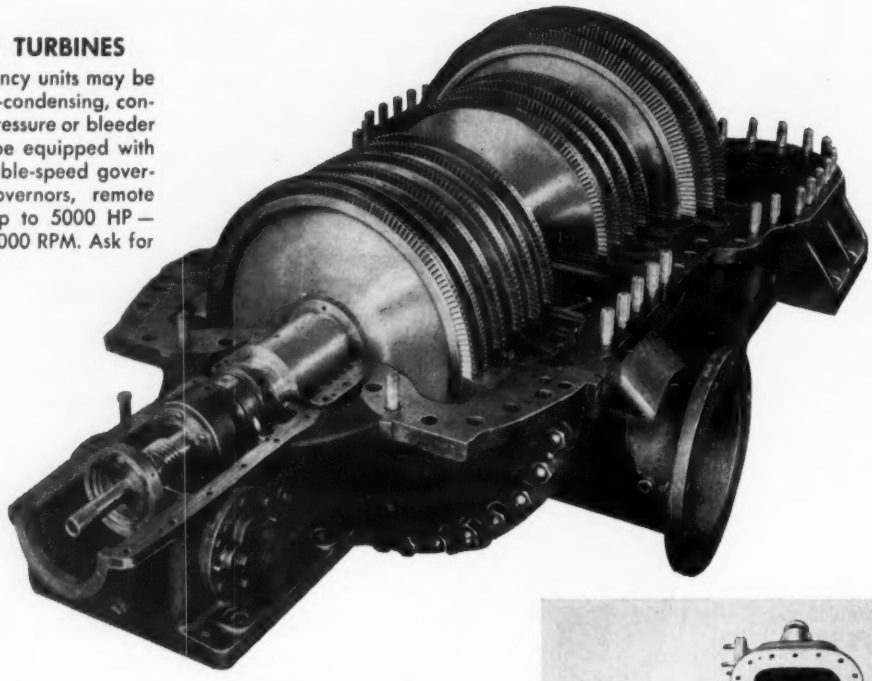
Flexible All-Steel Coupling

Colmonoy-Coated Shaft Sleeve Thru Stuffing Box.

For more facts circle 331 on Reader Service Card, p 102

MULTI-STAGE TURBINES

These high-efficiency units may be designed for non-condensing, condensing, mixed pressure or bleeder operation. Can be equipped with constant or variable-speed governors, special governors, remote controls. Sizes up to 5000 HP — Speeds up to 10,000 RPM. Ask for Bulletin S-146.



There's a **Terry turbine** for every mechanical-drive requirement

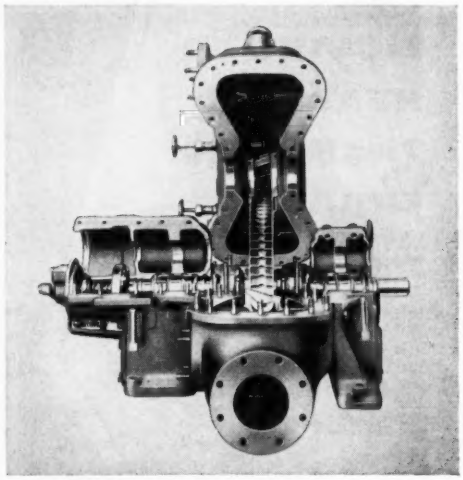
The designs for Terry turbines are based on more than 50 years of successful experience in the manufacture of turbine drives *exclusively*. This specialization has resulted in Terry becoming one of *the leading producers* of mechanical-drive turbines in sizes up to 5,000 horsepower.

There are three basic reasons why Terry has been able to maintain this position of leadership: (1) a thorough knowledge of the requirements of mechanical-drive turbines, (2) a willingness to build "a little something extra" into each machine to assure trouble-free operation, and (3) an acknowledgement of the company's responsibility to stand behind the performance of every turbine sold.

These are also the reasons why you should consider a Terry turbine for your next mechanical drive. In the meantime, send for bulletins describing any of the types of machines illustrated.

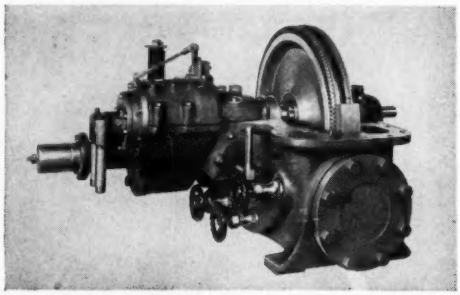
THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



SOLID-WHEEL TURBINES

Famous for sure dependability and ease of inspection. Can be started cold — no preliminary warming required. Available in vertical designs depending on frame size. Capacities from 5 to 2,000 HP. Described in Bulletin S-116.

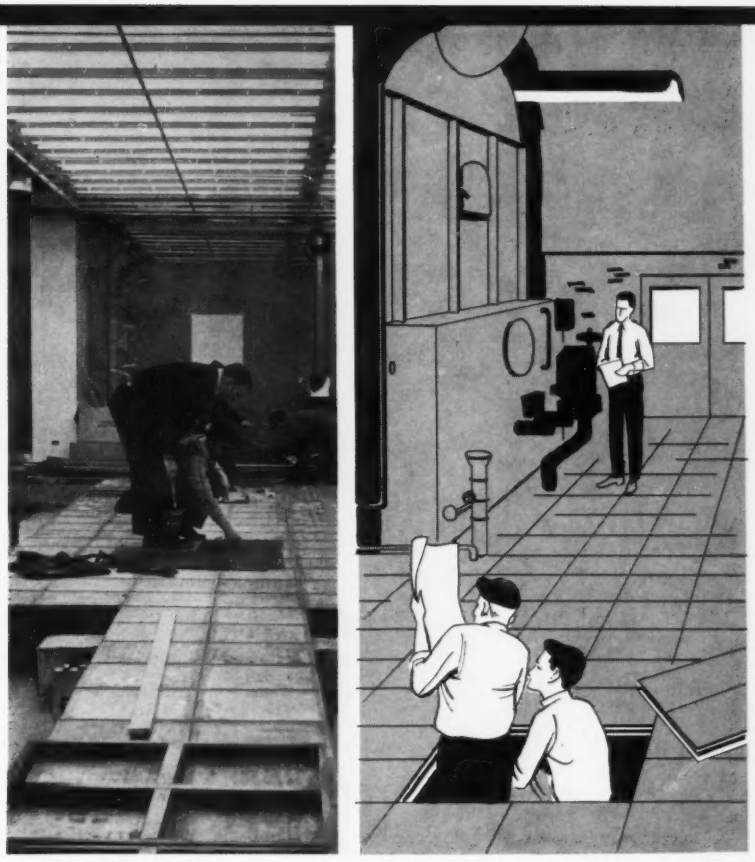


AXIAL-FLOW IMPULSE TURBINES

Built with one, two or three rows of high-grade stainless steel blading, these turbines combine efficiency with durability. Available in designs for moderate and high steam pressure. Bulletin S-143.

TT-1209

STEVE ELONKA
Associate Editor in Charge



COMPLETE FREEDOM in spotting power-service facilities is possible under easily installed floor, *left*. Maintenance men have access to any point, as in boiler room, *right*

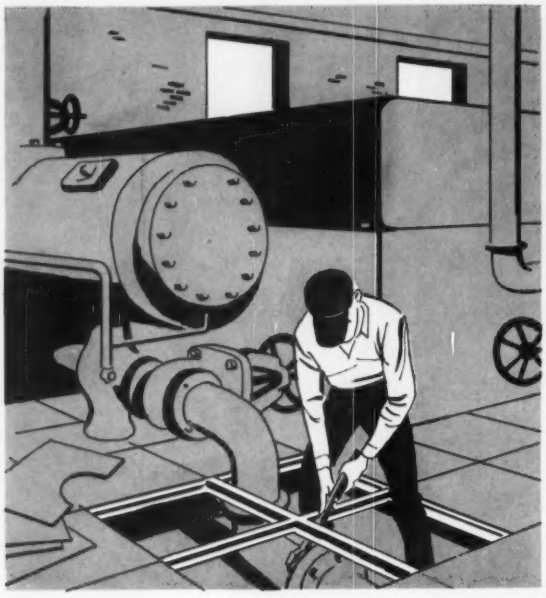
Under floor power services: A key to easy maintenance and growth

Why not check the possibilities offered by this scheme brought from ship to shore? Raised floor plates permit power-service flexibility in new or existing plants. They can cut operating costs, aid power-to-grow planning

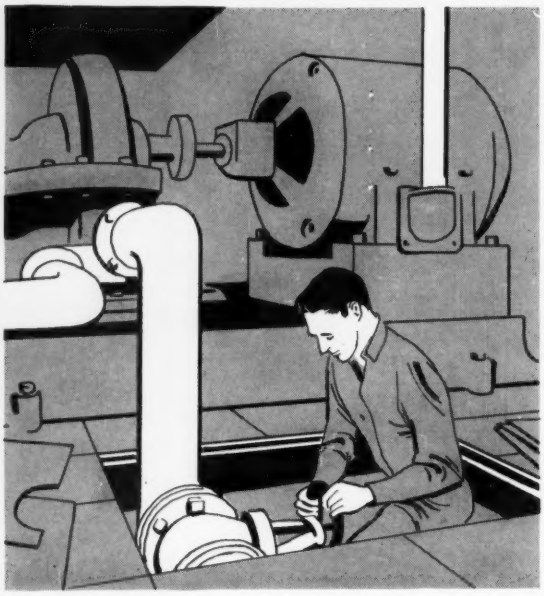
By JOSEPH SPISELMAN
Research Director
Floating Floors, Inc.

Historically, floors in buildings housing power-service facilities and production equipment have been strictly a "once-through" proposition. As an integral part of structure design, floors are set, as it were, to conform with planned needs. Generally of concrete, though not necessarily so, floors are trenched to carry piping, conduit for wires and cables, ductwork, etc. Once in place the trenches are covered with steel floor plates or metal grating and, for all practical purposes, are considered as permanent as the building itself. Changes, if later required, can involve considerable expense.

A new concept in floor design thinking is a "floating floor" that gives great flexibility, both initially and permanently, in design, operation and maintenance of power-service facilities. And with the present swing toward more



AIR SUPPLY, vital to many plant processes, can have underfloor piping network. Plates allow finger-tip maintenance throughout



PLANT WATER SERVICES lend themselves readily to underfloor scheme. Out-of-sight piping, valves, controls are quickly exposed

Put power services where you want them

and more utility and industrial power-plant construction, expansion and modernization, such flexibility can greatly simplify planning for most efficient space use. Too, it leaves a door open for relatively inexpensive layout changes at a future date.

What is the "floating floor?" Simply a modular assembly of cast-aluminum plates interlocked and supported by pedestals. One design uses a steel frame that with four plates forms a unit. Another design eliminates the frame, uses only plates and pedestals.

How are "floating floors" applied? All buildings have subflooring, of course, as part of the basic structure. In new construction, the floating floor is merely assembled on the subfloor by spotting the pedestals (which need no bolting) and laying the plates or plate-frame units on them. In existing buildings, the same procedure is followed. Existing floors become subfloors so far as the assembly is concerned.

Free access space between subfloor and floating floor can be used to install or relocate piping, cables, ductwork, etc, as desired. Valves, expansion joints in piping, instruments or other parts and appurtenances in the underfloor space are exposed simply by lifting the individual floor plates.

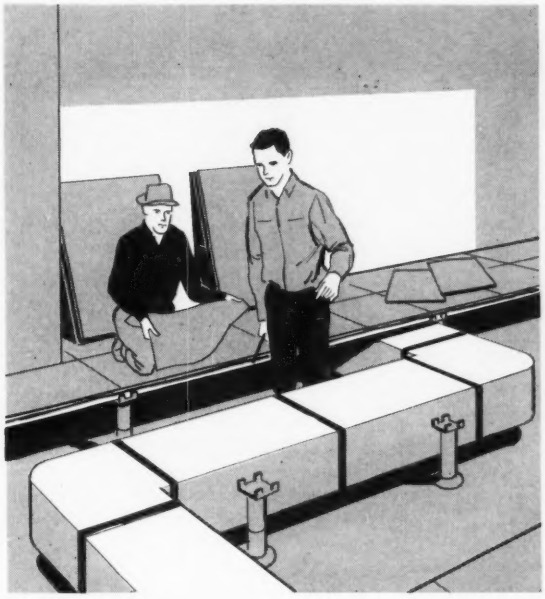
Electric power outlets, steam, air or hydraulic supply are no problem in moving equipment from one location to another. Supply lines are laid bare in a jiffy, joints broken and remade to conform to the shift with workmen able to have complete freedom of movement around the job. Floor plates previously cut to accommodate lines or cables passing through to terminal fittings attached to the equipment are simply shifted with the equipment. The same is true for plates fitted with heating-system or air-conditioning registers if the ductwork is relocated.

Floors are husky enough to withstand substantial loadings and the aluminum plates are highly resistant to surface marring by rolling loads provided, of course, that they're not abused in this respect.

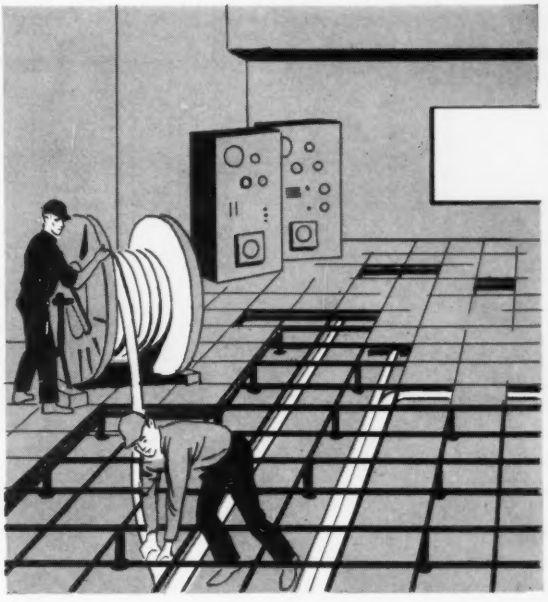
Important feature is the way these floors lend themselves to installation in irregularly shaped areas, around columns and finishing to walls. While not as simple as laying linoleum, process is somewhat similar. Plates can be cut for installation of air registers whenever needed. Both module frames and plates can be cut to fit flush against walls, columns, pipes or other structural features or installations.

Fact that both floor designs require nothing but assembly, with no supporting substructure or alterations to existing floors, give wide application possibilities. Initially, design thinking centered around problems involved in handling masses of cables, piping and ductwork necessary in computer installations, telephone switchboard rooms, industrial laboratories and film and recording studios. Here, equipment installation may be permanent, but odds are long that some reshuffling will occur from time to time. Some of this equipment must be air cooled, and moving ducts and relocating registers plus changing cable runs can be expensive. By having free access to subfloor space and flexible, easily rearranged or moved flooring, relocation cost is cut to the bone.

Consulting engineers and architects took a hard look at what was being done and saw interesting possibilities



AIR CONDITIONING ductwork (for heating, ventilating, too) goes under floor plates faster, at less cost than in walls and ceilings



POWER TO GROW *electrically* is big factor in today's industrial expansion. Cables on subfloor can simplify added distribution

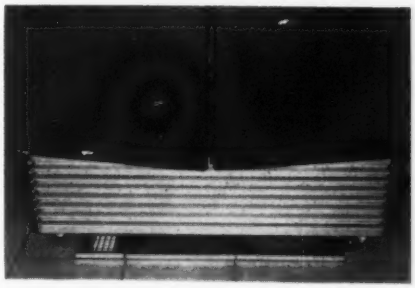
and where you can get at them – anytime

in applying these floor designs to utility and industrial power plants. Though much power-service equipment is normally considered to be permanently installed, today's plant management plans ahead, anticipates his expansion needs over the long haul. Tying in with this thinking, the consultant comes up with methods for adding more capacity to present power services with as smooth an integration as possible. In this vein, linking new equipment to existing systems is simplified to a considerable degree where access to project areas is easy and gives practically unlimited elbow room, as with these new floor designs.

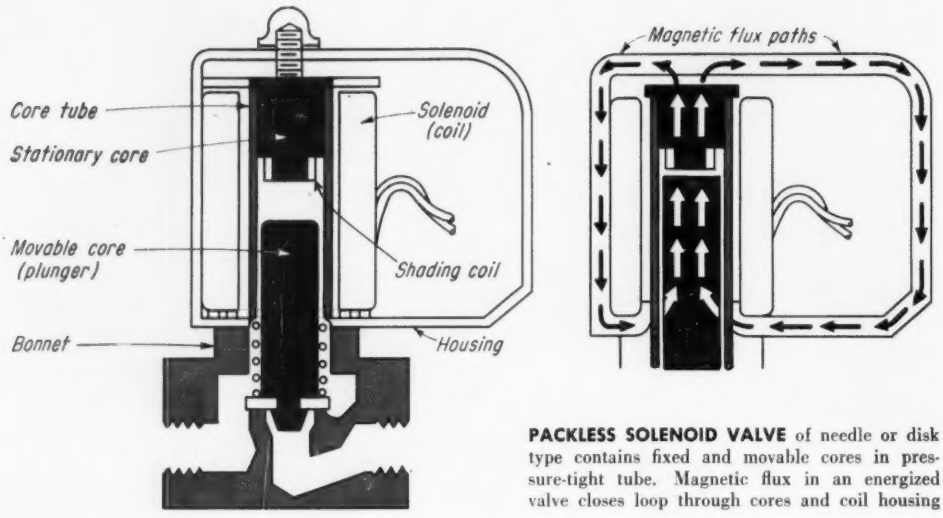
Another feature eyed by consulting engineers is that floors in both old and new buildings can be used as pressurized plenum chambers that supply air through registers, eliminate need for extensive ductwork and large outlets. With today's trend toward more compact, efficient heating, cooling and ventilating systems, such designs make it possible to put heating and cooling systems beneath the floor instead of in ceiling areas.

Maintenance of power services is perhaps the area in which biggest operating savings are possible. And quality of maintenance depends largely on how hard or easy it is to get at the equipment. Today's equipment designs reflect more and more the manufacturers' desire to make his product easier to inspect because it's no secret that good periodic inspection is a sharp tool in the preventive-maintenance kit. And this new floor scheme is conducive to good inspection. With little effort, large areas can be laid bare by maintenance crews. Removing some unpleasant aspects can do much to end the sometimes costly out-of-sight, out-of-mind approach.

PRESSURIZED PLENUM under floor is possible by using a gasket seal around floor perimeter



COOL AIR supply register, with plates cut to fit, easily transfers with relocated equipment



PACKLESS SOLENOID VALVE of needle or disk type contains fixed and movable cores in pressure-tight tube. Magnetic flux in an energized valve closes loop through cores and coil housing

By F E REEVES, Automatic Switch Co

Solenoid valves: what they are, what they do

As designers or operators of power-service systems, you probably use many solenoid valves. But, are you fully utilizing this major control item? Here, in Part 1 of a series, our aim is to help you make the best use of modern solenoid valves.

Basically, a solenoid valve electrically controls flow of gases or liquids. Since its operation is electromagnetic, one of its principal components is the solenoid. Trigger or workhorse, depending on whether the valve is direct acting or pilot operated, the solenoid consists of a coil, magnetic path and plunger (core).

Coils with organic insulation, impregnated for moisture resistance, are good to about 212 F, but excessive moisture or higher temperatures may cause failure. Resin-molded coils are water submersible, can take slightly higher temperatures. Coils insulated with silicone or "glass insulation" are good to about 450 F.

In typical solenoid-valve construction, above, coil tightly surrounds the core tube which must be of non-magnetic material—usually stainless steel since magnetic flux must pass through it. Plunger or core is often magnetic stainless steel for corrosion resistance.

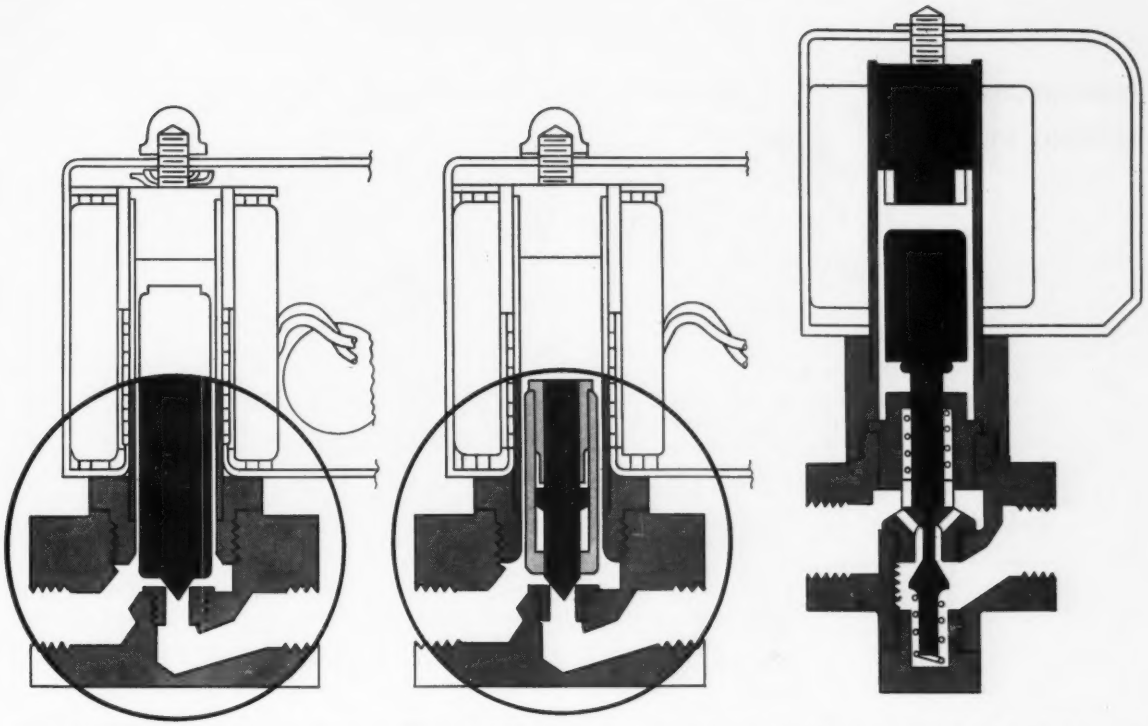
To reduce current requirements and power losses, magnetic flux path must be through magnetic materials with minimum air gaps. For this reason, the coil housing is usually part of the magnetic path. When valve body is also a part of the path, it must be of magnetic material. If solenoid housing is removed and coil energized continuously, it will overheat and eventually fail. Removal of the normal low reluctance path for the magnetic flux boosts current and causes the burnout. In confined locations a magnetic yoke may replace coil housing.

Solenoid enclosures, besides acting as the flux path, offer mechanical protection for the coil to conform with electric code requirements. Properly wired waterproof enclosures exclude moisture from the housing, and are essentially submersible, permitting burial in the ground.

Dc solenoids are very quiet in operation, except for the click when the core strikes the plug nut. Since ac reverses twice each cycle, it passes through zero value at that frequency. At these instants there is no force to hold the core against the plug nut. Unless prevented, core tends to fall away from its seat, resulting in noise. The noise would be a substantial hum if there were no load on the core trying to pull it away, but under loaded conditions the hum rises to a loud rattle.

Shading coil, shading ring or shader will usually restrict this hum or rattle to tolerable intensities when properly applied by simulating a low-resistance short-circuited transformer single turn—its flux nearly 90 deg out of phase with solenoid coil main flux. As main flux passes through zero the shading coil flux nears its maximum, greatly reducing noise.

Current in a dc solenoid is same regardless of plunger position. When plunger in an ac valve is away from its seat, current is large, gradually diminishing as core moves toward its seated position. While this factor helps valve operation, it is the principal cause of coil burnout in ac valves. If for any reason the valve fails to operate when the coil is energized, the high current if sustained causes excessive coil heating and failure. Valve sticking, improper voltage or excessive pressure are usually to blame. Cores for ac solenoid valves are usually deeply slotted or laminated to reduce eddy-current heating in operation.



NEEDLE VALVE'S smaller port area reduces power needed to open against fluid pressure

IMPACT CORE construction magnifies the coil power by hammer-blow opening action

NORMALLY OPEN VALVE fills a special need for valve that opens when power fails

Explosionproof housing for hazardous locations need not be vapor tight, but must not shatter or spread the explosion if gases seeping into the enclosure ignite. Gaskets which might blow out under such conditions are not permitted. Some enclosures may meet both explosion and weatherproof requirements if the flame paths are filled with special silicone grease.

Packless valves are not new, but there is a strong trend toward extended use because of design improvements and disadvantages of packed types, discussed in a later article. In the most common packless type, the solenoid plunger is immersed in fluid being controlled. Core tube must be sealed against leakage and be capable of withstanding maximum fluid pressure. Most core tubes are nonmagnetic stainless steel for strength and corrosion resistance. Packless valves may be classified as: (1) *full pipe-area valves,* where orifice is equivalent to inside area of the connecting pipes (2) *needle valves,* in which the orifice is usually smaller than the pipe area. They may also be subdivided by operation as the *direct-acting* and *pilot-operated* type. Again they subdivide into *normally closed* and *normally open.*

First drawing is of a full pipe area, direct-acting, normally closed solenoid valve. Such a valve is necessarily limited to low pressures: a few pounds in small sizes to a matter of ounces in the larger sizes. This is due to the limited power available in solenoids.

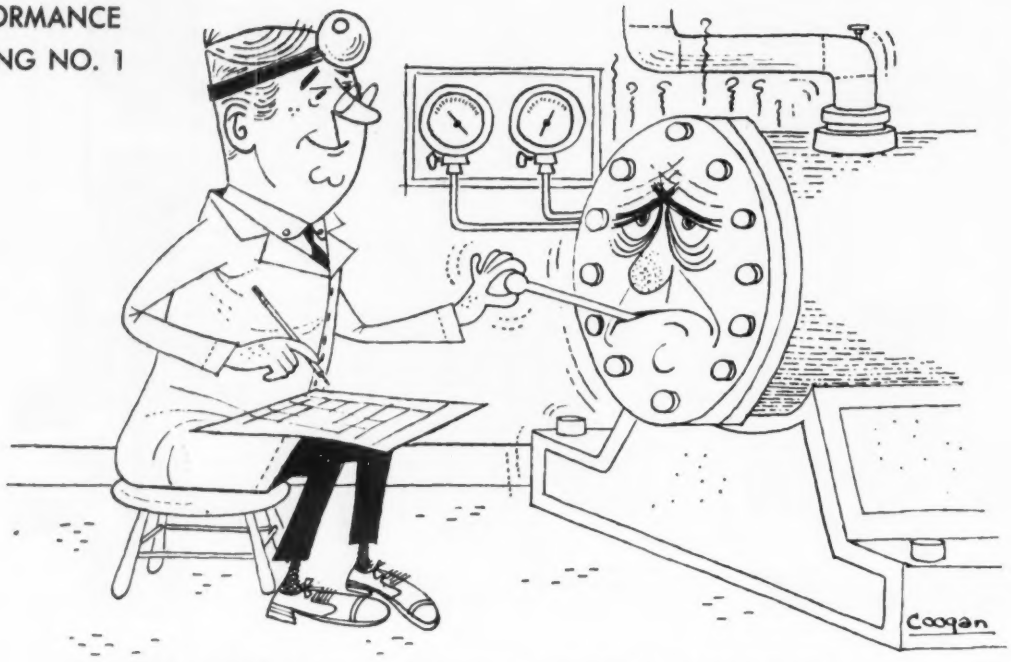
Force necessary to open the valve, with line pressure on the upstream side and atmospheric pressure on the downstream side, is the line pressure in psig divided by orifice area in square inches. In a direct-acting valve this force plus safety margin must be available in the solenoid.

Needle valve handles much higher pressures because of the reduced orifice area. Lower flow rates are partially compensated for by higher pressures. Needle valves are therefore very popular in instrument work because of their relatively low cost.

Impact core construction gives more force from a small-size solenoid. In this valve the magnetic core travels a short distance upward before it picks up the load of the valve stem and needle disk. The disk receives a hammer blow upward, using kinetic energy stored in the core. Such a valve opens against much higher pressures than with integral core and disk valves. The same valve features "floating core construction" and a larger air gap above the core. When energized, the core rises to strike the plug nut but falls back to the magnetic center of gravity of the core. The core floats in that position as long as the coil is energized, and operation is much quieter than standard designs. No shading coil is necessary in such a valve, but holding current is slightly higher due to the larger air gap.

Normally open valve, as applied to any electromagnetically operated valve, indicates its de-energized condition. Majority of solenoid valves are of the normally closed type, energized to open. I strongly recommend that normally closed valves be used if at all possible because of price, availability and simplicity of design. Fewer types and sizes are available in normally open construction; they are needed only when a valve must open when power fails. Most valves have continuous-duty coils and may be energized 24 hours a day, 7 days a week without difficulty. So it's better to redesign an electrical circuit to make maximum use of normally closed valves.

PERFORMANCE
TESTING NO. 1



PERIODIC CHECKING of operating performance pays off—if you know how to do the checking

Performance checks can cut your costs

Small performance errors add thousands to operating costs. With this article, *Power* starts a series to help you get peak efficiency from each power service

By L E STEWART, Assistant Editor

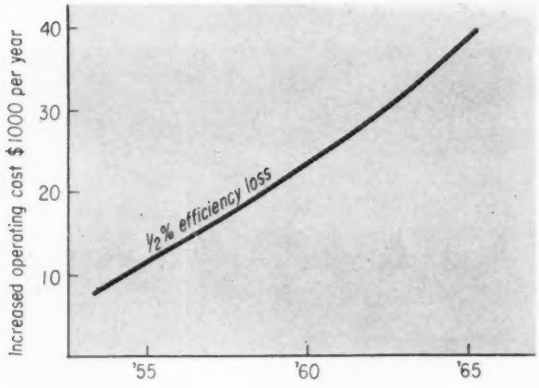
Power-service engineers enthusiastically endorse preventive-maintenance programs as a proven moneysaver. But many of the same men would be hard put to justify periodic performance testing of plant equipment. This is usually due to the general lack of information concerning performance-testing cost and operating savings that can result from sensible test methods. Also, performance testing is considered too complicated for the average plant engineer. This last point is valid for the superprecision testing done by many equipment manufacturers, but not so for adequate operating checks. A "no frills, all business" test annually and whenever special information is needed can be handled by any good power engineer —and it can result in real savings.

As an example: superheater-tube failures in one boiler of a plant were temporarily fixed by blanking off tube stubs. This cut steam temperature 30 F. Since the boiler-turbine concerned was the plant's newest set, operators elected to push its capacity rather than swing load to older, usually less efficient units. In the six months until the new unit was permanently repaired, operators wasted some 0.5% of the annual fuel cost by not picking up load on older units. A relatively simple performance check would have shown the new boiler-turbine cycle to be the least efficient one in the plant under the special circumstances.

Trouble shooting. The same type of performance "spot check" for other power-service equipment would be equally helpful for indicating when to dump load rather than operate inefficiently, justifying unscheduled repair shutdowns or even spotting malfunctions before they become obvious repair jobs. In the general area of trouble shooting, accurate, consistent performance data often is only basis for spotting basic faults.

However, periodic performance testing can be expensive and time consuming. Some special instrumentation must be kept on hand. Before you can justify spending time and money on such a program, you should estimate the possible annual operating savings.

Small errors mean big money as average unit size, fuel prices rise



Performance error	Deviation
Steam temperature: below 800 F	–12 F
Steam temperature: above 800 F	–10 F
Steam pressure: below 1000 psig	–15 psig
Steam pressure: 1000 to 2000 psig	–10 psig
Condenser vacuum	+0.08 in. Hg
Condenser subcooling	–8 F
Boiler exit gas temperature	+12 F
Excess air, units with air heaters	+2.0%
Excess air, units without air heaters	+1.0%
Moisture in the fuel, as fired	+2.5%
Unburned combustible	+7.0%
Probable efficiency loss	**0.5%**
Summation of all losses	1.75%

COST PENALTY for inefficient operation justifies expense and effort of periodic performance tests. Efficiency loss of 0.5% or greater can result from typical operating errors listed. Figures are broad approximations based on selected power-service designs

When automatic combustion controls were first installed, they were justified on basis of a 0.5% efficiency increase. A sensible performance-checking program should be able to show an equal return.

Fuel costs and industrial power plant unit capacities will increase in the next few years. The single curve, above, represents the rising penalty to American industry for low efficiency as fuel prices and average unit size increase. The accompanying table lists several "performance errors" which could produce a 0.5% efficiency loss. Values listed are rough approximations based on selected plant cycles and broad ranges of operating conditions. Specific values for your plant can be worked out or obtained from your engineering consultants or equipment manufacturers.

Many of the errors listed above are smaller than minimum differences recording or controlling instruments can measure accurately. Errors can persist unnoticed for long periods due to recorder or controller drift, instrument hysteresis or improper calibration. This does not mean controls are inadequate. Extreme precision controls can be purchased, but usually are not needed for operation of power services. Test-instrument precision is not required in control—merely repeatability. Adequate accuracy is achieved by proper calibration of controls having "commercial" precision.

Again, many errors are indirect effects of seemingly unrelated problems. One industrial plant complained of lowered turbine output. Eventual performance tests revealed fouling in the low-temperature feedwater heaters, boosting high-pressure heater demand and cutting turbine power for a given throttle flow.

Another classic case concerned reported high boiler exit gas temperature and increased draft loss of one small unit. Test data quickly showed high excess air to be the actual culprit rather than dirty boiler surface as originally supposed. These and many other operating problems are solved through test data.

In planning stage, the following 5-point program will help you prepare for effective testing:

1. Analyze plant cycles and decide what portions need periodic checking.
2. Check with equipment manufacturers for the best method of calculating performance. They often have simplified formulas and techniques they are willing to describe.
3. From the calculations, determine information needed and measurement accuracies required to make the check tests worthwhile.
4. Locate best possible test points for all needed data. This probably is the most important part of the whole operation. Less than 100% effort at this point is liable to render all your other work useless.
5. Select test instrumentation to fit your accuracy requirements and check loan of special items.

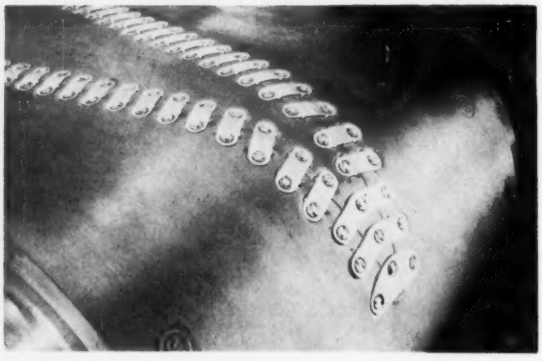
In instrument selection keep in mind equal accuracies are not needed for all readings taken during tests. Key to successful testing lies in matching measurement precision to accuracy requirements. This is best done by using test-quality instruments only where their extreme precision is needed and by modifying test procedures to compensate for inherent inaccuracies in instruments wherever possible. For instance, many temperature and pressure readings requiring precise measurement are eventually used as differentials in performance calculations. Under these circumstances, measurement techniques are modified so instrument calibration and hysteresis cancel out.

These pointers, then, are the basis for an adequate program of performance testing, sensibly tailored to your needs and pocketbook. In following articles POWER will show you how to apply these fundamentals to specific equipment and cycles in your plant.

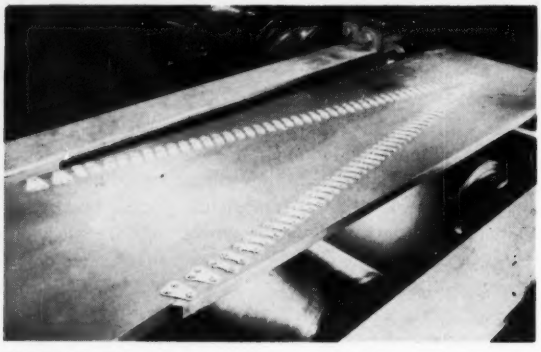
OPERATORS' NOTEBOOK **127**

This conveyor-belt splice

FIELD INSTALLATION is speeded up on this large conveyor belt because the mechanic can do the job with easy-to-assemble parts

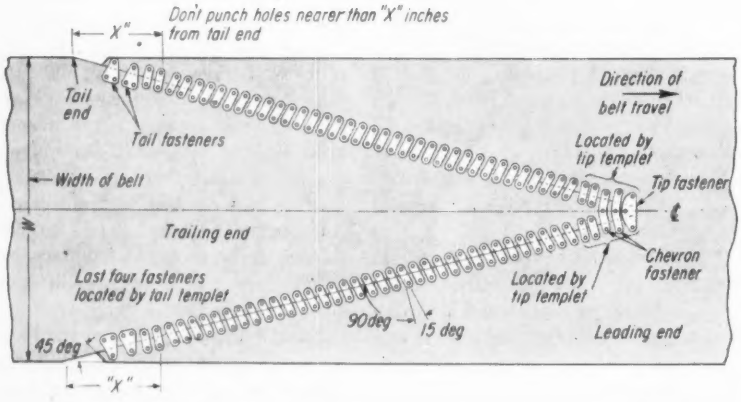


TIP END of the splice is held together with fasteners at angle. Fasteners rotate slightly, bring the cut edges closely together

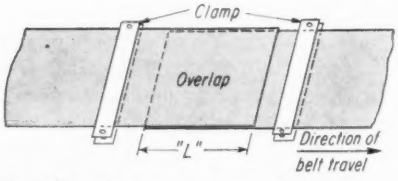


TRAILING END has two fasteners installed at different angles. The cut edges close tightly, helping to make the seal permanent

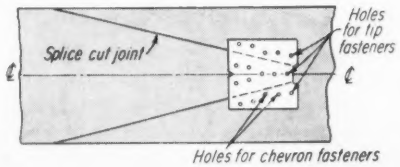
Here's how you cut and install the splice



SPLICE IS V-SHAPED, is held together with a metal bolt and plate fasteners. The tip and tail fasteners are specially constructed and installed at different angles to help stabilize belt movement and to anchor the tip and tail ends securely. Parts kit comes complete with templets for bolt-hole locations and the installation instructions you need



1 Pull the belt up to the desired position around pulleys and clamp it near ends



5 Position the tip templet on the center line; nail down, then punch tip holes

does away with field vulcanizing

By STEVE ELONKA, Associate Editor

Here's why splice has vulcanized rating

Maintenance men have accepted field vulcanization of conveyor and elevator belts for years because that was about the best way to do the job. But now an improved splicing method has been developed. This patented splice is claimed to last longer for most belt applications.

Fastener splice, photos, left, has vulcanized splice rating. Registered as the Wedlock Splice, it's a high-tension mechanical fastener splice. It consists of a V-shaped joint that forms a seal under tension. The splice is secured with specially designed tip and tail fasteners anchored at the ends of two rows of bolt and plate fasteners.

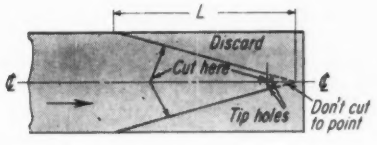
According to the manufacturer, experimental and on-the-job tests have proved the splice to be dependable, safe, tight and durable—equal to vulcanized splices for operating tensions up to 700 psi of width rating on belts of five or more plies and thicknesses of ½-in. and over. You can now use this fastening method on belts of natural or synthetic fabrics, cord construction, or any combination strength member construction with the exception of steel wire. This makes it an all-around splice.

Easy to install. Illustrations show details of an assembled splice. You can field-install the complete splice quickly with ordinary skill and the tools needed to make a conventional Flexco bolt and plate fastener joint. Because it's quick, this splice reduces downtime. Length of splice is determined by width of the belt and operating tensions that are needed for your particular installation.

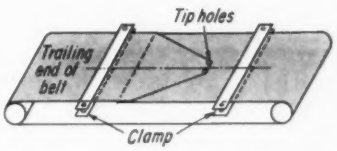
Tight splice. Installation of fasteners across the splice-cut at a predetermined angle permits fasteners to rotate slightly under tension. This causes belt edges to close tightly and form a permanent seal during their operation. No. 2 Flexco fasteners with monel tip plates are best for maximum service on heavy-duty conveyors and elevator belts. Reason is that monel has 6 to 7 times better abrasion resistance than steel. These fasteners are fully protected by a United States patent.

Steel top-plate fasteners may be used. Monel is also used for special tip and tail fasteners to provide maximum abrasion resistance, long life for heavy-duty jobs. One big advantage of this fastener method is that you can see at a glance the condition of this new splice. Why? Because broken or worn plates are easily replaced and the life of the splice may be extended indefinitely. Only one size fastener is required for all tension ratings and belt thickness up to 1¼-in. Thus inventory problems are solved to a large extent.

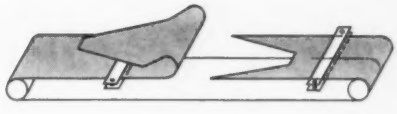
Assembly kit. Materials needed for doing this job include an assembly kit containing special tip, chevron and tail plates, instructions and license to make one splice. You need the proper quantity of plate fasteners and special templets for locating holes to punch. Assembly kit and templets are available only through the manufacturer's authorized marketing channels.—*Courtesy, Manhattan Rubber Division, Raybestos-Manhattan, Inc*



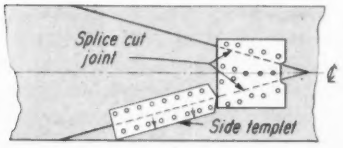
2 Draw center lines, layout and cut splice V-shaped according to data given in kit



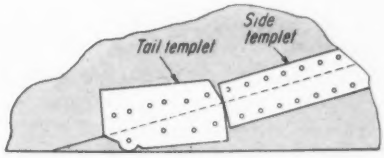
3 With punch furnished in kit, punch a hole in trailing end; cut trailing end



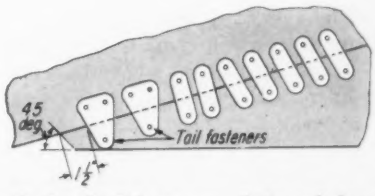
4 Now cut marked shape of leading end to exactly fit the V of the trailing end



6 Punch side holes through side templet; move templet to finish remaining holes



7 Use square end of the side templet to position tail templet; punch tail holes



8 Install all fasteners—tail, tip and chevron. Tighten by hand or impact tool

Lay plans now for springtime startup of air conditioning

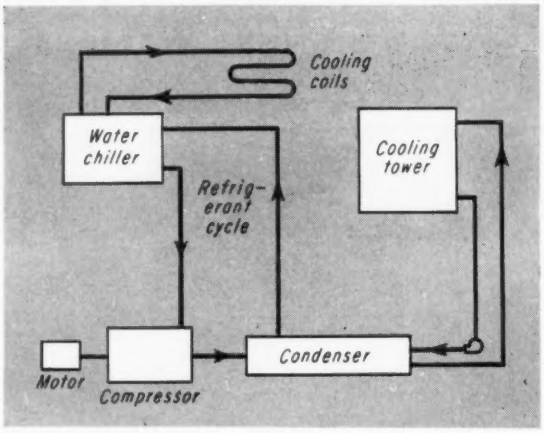
By W A BINGHAM JR, Carrier Corp

There isn't any one best way to start up an air-conditioning system; much depends on last fall's shutdown routine and the type of conditioning setup you have. One sound approach toward getting your machinery in top working shape is to separate entire system into two major divisions—*air handling and refrigeration cycles.*

Secondary cycles—water, control, electrical circuits, cooling tower—fall under these divisions. Chop job into small packages, follow an overall plan, and your men will do a better inspecting and service job before they push the start button.

Tackle air handling first. If yours is a central air-conditioning system, fans may run both winter and summer. Although fans should get regular inspection throughout the year, they still need a thorough once-a-year checkup, including possible repairs. Schedule this work to coincide with your spring startup routine.

Next, hit the other division—*refrigeration cycles.* Order of attack



CYCLE CHECKOUT must include cleaning, replacing and aligning

Work one system division

Air-handling equipment requires a common sense plan of cleaning, replacing and adjusting. Clean fan wheels, clean or replace filters, check bearings for wear and corrosion and motor-fan couplings or belts for misalignment. Inspect the power supply and fan dampers. Then check their operation.

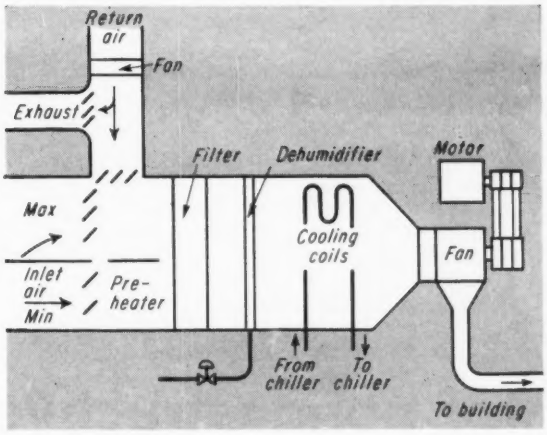
Ducts may need cleaning. They don't need it often (every 5-10 years), but when they do some plant engineers prefer to call in an outside cleaning contractor to do the job. If your men do the work, scrape first, then use an industrial vacuum cleaner. Be careful of dust and fume hazards. Good cleaning is a must, it eliminates dirt that may be blown through the building when fans are started.

Check instruments and controls for response, accuracy, calibration, insulation breakdown and inspect automatic valves for air leaks, lubrication needs and sticky stems.

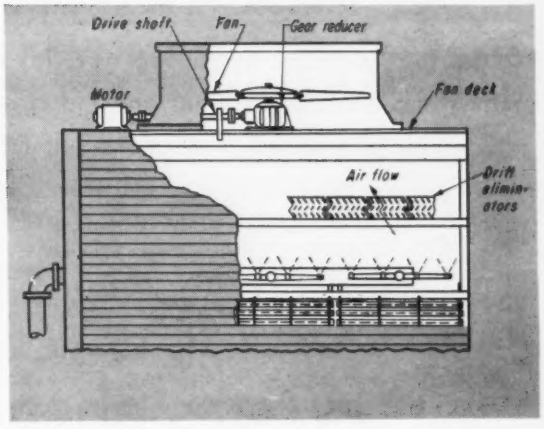
Cooling tower. When weather permits, clean out all sludge and accumulated dirt, then paint. Inspect spray nozzles so you know they're clean before starting the pump.

Replace gear-case oil and check gear teeth for wear. Most trouble signs can be spotted visually; use feeler gages to determine backlash. On the pumping side, clean strainers in the water line leading to the condenser, then clean and flush the chilled-water circuits.

Take a good look at fan blades. Since air recirculation and fluctuating air loading can set up metal fatigue, inspect blade roots carefully for signs of cracks. If you have baffle plates at the fan center, again search carefully for cracks from air loading; then make sure all your fasteners are tight.



AIR-HANDLING CHECKUP involves filter, fan, motor, coupling



COOLING TOWER water treatment, parts lineup are vital areas

at a time: air, refrigerant, water, control and cooling tower

Misalignment of motor and gearing may stem from tower swelling and shifting with temperature changes. If alignment is out you can expect gear wear. Pumps also get out of line. Look for impeller wear, then inspect labyrinths and packing for leaks. If water circuits were drained at shutdown, refill during tower checkout time, leaving vents open until all air is purged.

Tower-water treatment needs checking. Sound program in this area is important. (See *Water Treatment* Part I, December 1958 and Part II, p 65-88, this issue)

Refrigerant cycle. Put refrigerant back into unit and replace oil and filters if not done at shutdown. It's best to replace oil at end of summer since acids in used oil may corrode parts during winter layover.

If condenser tubes weren't checked at shutdown pull the heads and check for sludge and scale. Use brushes recommended by the condenser manufacturer to remove any soft sludge. If hard scale is present you'll probably need chemical cleaning to remove it.

Change oil in speed increaser and high- and low-speed couplings. While working on couplings check teeth for wear and the coupling itself for alignment. Couplings out of line can cause damage to compressor seals, thrust bearings, increaser gears, motor and turbine bearings, shaft seals.

Refrigerant leaks are hard to fix once the system is in service. So run a leak test before startup. With centrifugals or reciprocating compressors, put machine under nitrogen or air pressure (or any inert gas), add a little Freon and go over all joints carefully with a halide leak detector.

Keep pressure in low-pressure centrifugals at 5 psig or below. Higher pressures will open the floating seal faces on the main shaft, causing leaks. High-pressure machines can take up to 80 psig, since they have carbon contact seals. Damage here from a leak test shouldn't be much of a worry.

Absorption-unit startup differs from compressor-driven chillers on several points. First, to run a leak test, put absorption unit under 28 in. vacuum for 24 hours. If vacuum doesn't hold, apply 16 psig gas pressure, following the leak test outlined above.

Other hints on absorption chillers: (1) Check automatic capacity control valve for smooth action. Paint and dirt can make stem, seat or linkages sticky producing jerky valve motion. Also inspect the rubber diaphragm in lithium-bromide line. Valve's weak point is the diaphragm, since it can take a set, losing elasticity. If diaphragm doesn't have good bounce, replace it. (2) Purge tank cleaning must include probes and jet pump housing vents. Cleaning probes keeps them sensitive, yielding better machine control; cleaning vents prevents water from working up pump shaft into motor housing. (3) If the vacuum tubes test out on the weak side, throw them out. Also get spare tubes as a good low-cost insurance against lengthy shutdown from tube failure.

These tips are most general. For specifics, stick close to the equipment manufacturer's recommendations. Finally, look back to POWER, May and August 1957, for viewpoints of servicemen and users on outside equipment-service contracts.

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isn't too important but each system must be checked out. Hold close to the major division plan or you'll boost chances of leaving items off the list.

Check parts list and decide what replacements will be needed at start-up—what spares you'll need during the coming season. Put filters, oil, lubricants, gaskets, refrigerants in stock before startup day arrives. This single planning step cuts time lost waiting to get parts once you've opened the equipment.

During checkup you'll find certain parts showing need of replacement in the near future. Don't figure life on these parts too closely. If it appears they might not last the cooling season, yank them out and replace now.

Summer maintenance. While planning your spring startup, look ahead to the summer inspection schedule. Work up inspection intervals and check this with your equipment makers. Combine their ideas with those who have similar systems to get best checkup schedule, spare-parts list.

To get the reliability demanded of today's electrical equipment in both central stations and industrial plants, maintenance men are taking a hard look at nondestructive testing. Here, in the first of a series, we explore . . .

What's ahead for nondestructive electrical testing

By NORMAN PEACH, Associate Editor

The condition of electrical insulation is a vital factor in the performance and reliability of electrical equipment. Behavior of insulation under operating conditions in a machine or cable duct is much more complicated than as a sample in a material test. It's very desirable, therefore, to have dependable nondestructive tests that will tell us how reliable the insulation is: (1) at the time of manufacture (2) following installation and (3) after years of service.

Electrical equipment for which maintenance testing is advantageous is: (1) rotating machinery (2) cables (3) transformers (4) bushings (5) switchgear. While the nature of insulation deterioration and failure is similar in these groups and basic tests are the same, the problems of testing are different, and so is the relative effectiveness of the tests.

Large rotating machinery tests are of increasing interest because the large sizes of new units and reduction in standby capacity make reliability of supreme importance. POWER conducted a spot check of utilities, manufacturers and independent engineers in this field. A majority of those queried were investigating one or more nondestructive tests. Some had many years' experience with particular tests. Of course, concern with nondestructive testing of large rotating machinery windings isn't a new development. Tests in use today have been known for many years, and much has been written on the subject in the past two decades reflecting the experience of individual investigators.

Opinions of experts differ, and if you are planning a maintenance program you may find yourself confused. We shall try in this series of articles to clarify the picture and give a practical approach. In line with this, there's a helpful pamphlet published by the American Institute of Electrical Engineers, 33 West 39th Street, New York 18, N. Y. Its title: *Guide for Insulation Maintenance for Large Alternating-Current Rotating Machinery* (AIEE No. 56). Pamphlet reviews the factors which affect insulation life, recommends methods of performing tests and observing trends. Although the guide is intended only for machines 10,000 kva or more, it's useful for smaller machines, too.

Experts do agree that no one test is completely adequate to predict insulation life, and visual inspection is an essential accompaniment. Engineering judgment based on long experience with windings is the final arbiter. This judgment, however, needs all the help it can get from objective testing methods. Knowledge of the types of materials used in the complex insulation structure, and kinds of deterioration to which they are subject, is of great value.

Nondestructive tests for ac windings in use today fall into these classes: (1) insulation resistance at low voltage (2) insulation resistance at high voltage (3) dielectric absorption (4) alternating-potential overvoltage (5) direct-potential overvoltage (6) power factor (7) corona (8) specific tests, such as for conductor insulation, rotor field-coil turns and interlaminar core insulation. Other tests are under investigation.

L-v insulation-resistance tests under 5000 direct volts) are commonly made on ground insulation to detect contamination of solid insulation or insulation sur-

What is nondestructive electrical testing?

Nondestructive testing is a well-known concept in the design and maintenance of mechanical elements. Techniques are varied and well developed, and results are conclusive to a high degree. (POWER's Special Report, March 1958.) Nondestructive testing of electric power equipment (that is, testing the insulating elements in their proper relationship to the machine) is not clearly defined, and interpretation of results is sometimes controversial. At the same time there is increasing interest in perfecting this kind of test.

An ideal nondestructive test would reveal incipient faults and predict insulation life without causing breakdown or weakening of marginal insulation. Insulation-resistance and power-factor tests are truly nondestructive, but it's probably fair to say in the light of experience so far, that the more truly nondestructive tests are less conclusive than those involving risk of breakdown.

This leads us to a broader definition of a nondestructive test as one which does not impair "good" insulation, though it may cause breakdown of marginal insulation. Thus insulation that's "good" is a safe risk at time of test; insulation that fails is considered a bad risk although treatment might have improved it. Overpotential tests, such as the familiar in-factory test of twice the rated voltage plus 1000 v, are nondestructive in this sense. Some engineers have set up maximum potentials for their maintenance tests.

face by moisture, dirt, etc. These tests indicate the need to clean and dry the winding and make a meticulous visual inspection before applying more searching tests. Usually complete but clean ruptures in the ground insulation aren't revealed. Tests are of greatest value when taken periodically so trends can be discerned. Refer to POWER, July 1956, pp 118-119.

H-v insulation-resistance tests with dc usually reveal insulation characteristics not disclosed by l-v tests. Investigation is most active in this area, with many views held on how to test and interpret. To bring some order to independent investigations, a working group has been set up by the Insulation Subcommittee of AIEE. It is now studying the various methods with the objective of preparing an overall report.

Current observed when direct potential is applied across insulation has three components: capacitance current, absorption current and leakage current. The first two components decrease with time (depending on type of insulating materials, their size and arrangement), eventually to an insignificant value. This leaves leakage current which depends simply on E/R. If voltage is increased in steps at fixed intervals, length of the intervals to some extent determines the values observed. This gives rise to a variety of ways for conducting tests.

Dielectric absorption tests make use of the absorption current which is of relatively long duration compared with the capacitive current. Insulation resistance-vs-time curves are made for fixed periods, usually up to 10 minutes or until resistance stabilizes. Slope of the curve is expressed as the 10- to 1-minute insulation resistance, and is called the *polarization index*. Values for this index have been established for clean, dry insulation of various kinds. Dielectric absorption tests are made at both high and low voltages.

Alternating-potential overvoltage tests have been employed for many years by a number of users of h-v ac machines. Test voltages vary to as high as 1.5 times rated voltage. Overvoltage tests (direct as well as alternating) are intended to assure that the winding insulation has a certain level of insulation strength. It's generally believed that such a test should at least be able to detect a complete puncture of the ground insulation or insulation which is seriously cracked.

Besides providing knowledge of minimum insulation strength, advocates of alternating-potential tests believe they give a better approximation to actual service conditions than do the direct-potential tests.

Direct-potential overvoltage tests are getting increased attention. Some investigators are combining direct-voltage tests with long-established alternating-voltage test programs. There is a vigorous controversy among other investigators as to whether alternating- or direct-voltage tests are more informative. Both sides present evidence seeking to prove that their favorite more effectively meets requirements of a maintenance test on armature windings of rotating machinery. Which test is more suited for your maintenance program may be decided by the relative convenience of the test, size of machines and other factors which we plan to take up in a later article.

Power-factor tests on insulation are made by special bridge circuits or by the volt-ampere-watt method. Increasing insulation power factor in tests made at successive maintenance intervals is believed to denote a general deterioration. Because of the effect of external conditions, it is usually impossible to correlate power factor with insulation strength or to predict incipient breakdown.

Corona tests are made to detect the presence of corona in insulation voids and coil surfaces, and slot-discharge corona where adequate conductivity between the coil surface and slot doesn't exist. Special test sets are made for this purpose and considerable work is being done to perfect corona testing. Corona tests only determine a winding's susceptibility to corona formation and don't directly indicate its condition or predict life.

Plant Electrical Fact File

NO. 34: RELAYS

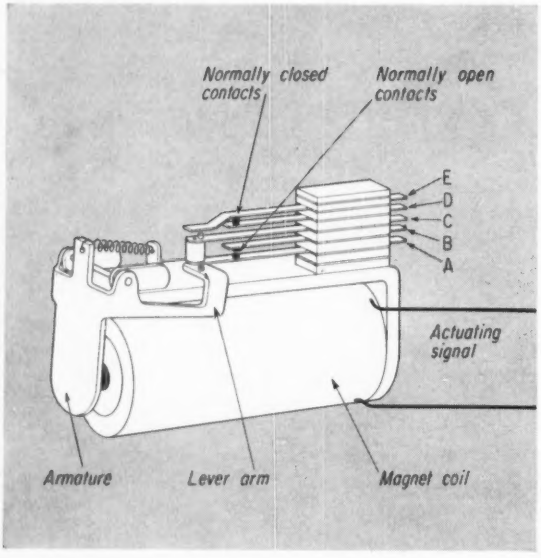
7 basic relay mechanisms

By NORMAN PEACH, Associate Editor

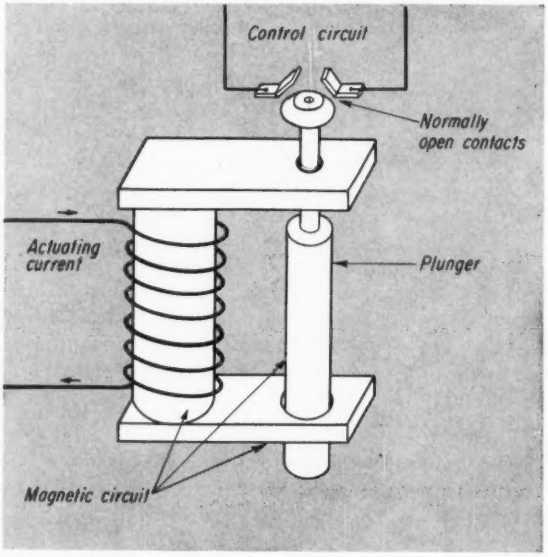
Relays are used for many purposes; they're called on to give protection and to execute complicated control functions. Most common of today's many types are the seven basic relays described here.

Simplest relay function is to transfer a signal from one circuit to another. But often amplification of a weak signal to a stronger one is required. Relays are of great value where they are capable of "recognizing" certain conditions and responding accordingly. The overload relay (an overcurrent relay with time delay that's inversely proportional to the current) is a familiar example. The directional relay is another common type.

Saturable reactors — comparative newcomers — are known as *static relays* because they have no moving parts. They're finding many uses in the industrial control picture, in numerous modifications. Dc can be supplied by tiny semiconductor rectifiers built in the relay assembly.

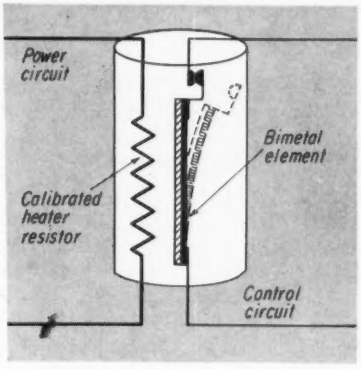


VOLTAGE RELAY *picks up* at a certain value, *drops out* at another value. Voltage differential depends on relay design, control function. Relay shown is electromagnetic-attraction type with armature. With this contact arrangement, pickup closes contacts between *A* and *B*, opens *D* and *E*. Design variations include ac and dc operation

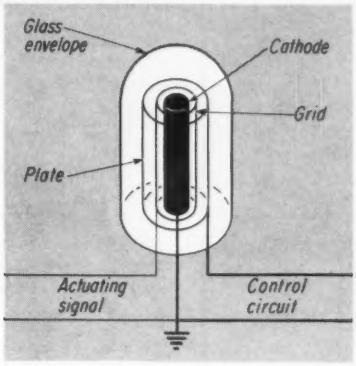


CURRENT RELAY responds to changes in current, is in series with all or definite proportion of current to be monitored. A dc plunger type is shown. When current reaches preset value, magnetism is strong enough to lift plunger up and close contacts. Timing device is frequently incorporated to give the relay inverse-time characteristic

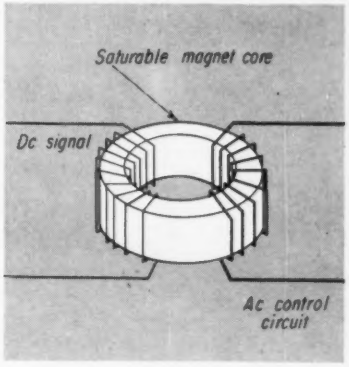
Three different relay principles



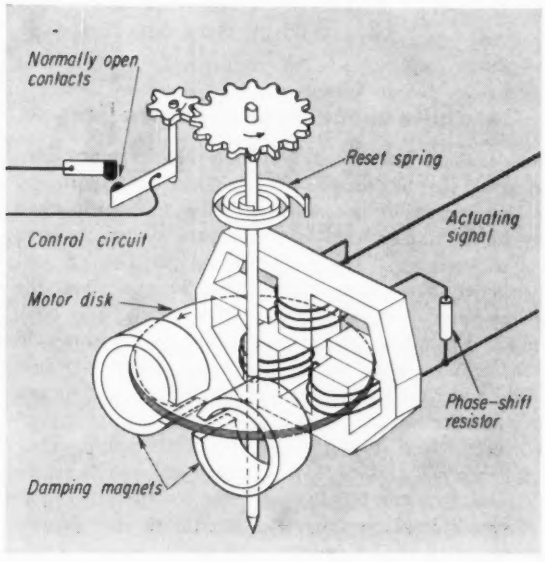
THERMAL RELAY acts on expansion proportional to I^2R of calibrated resistor. Inverse time is inherent feature. (*Fact File* No. 22, Feb 1958)



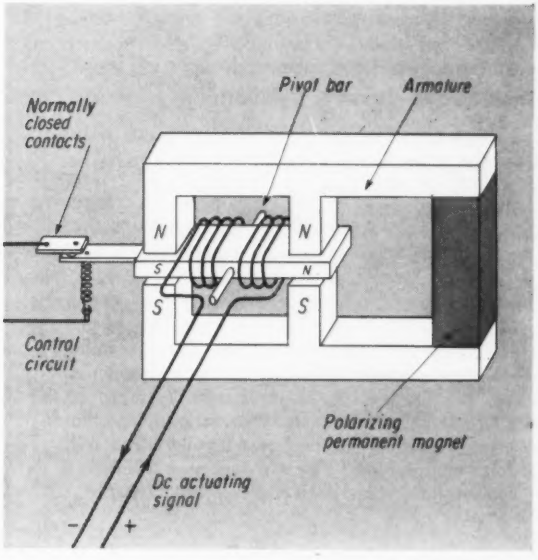
ELECTRONIC RELAY responds to a very weak signal (such as light energy in photocell). Signal on grid causes plate-to-anode current to flow



SATURABLE REACTOR has extremely high reactance to ac until dc signal saturates core. Reactance falls to low value, thereby "closing the switch"

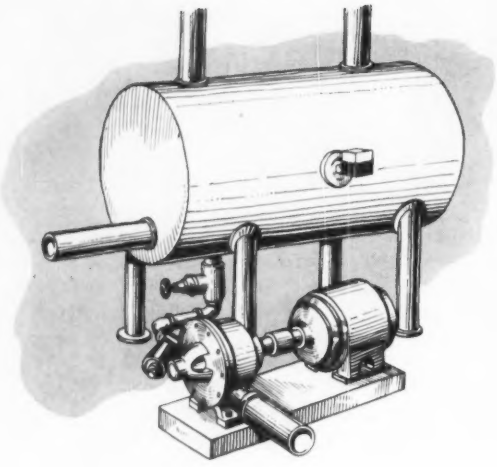


INDUCTION RELAY is used for many ac protective-relay schemes. Relay is essentially a disk motor; its torque is proportional to actuating signal. Sufficient rotation closes contacts. Type shown resembles watt-hour meter; X/R ratio of windings produces split-phase torque. Reset spring returns disk to normal position for next operation



DIRECTIONAL RELAYS detect reversal of polarity, power flow, etc. Dc polarity type is shown. Permanent magnet establishes field. Actuating signal magnetizes armature to react with field to hold contacts closed. Reversal of signal reverses armature flux, opens contacts. Ac directional relays are designed on the induction principle

These plant problems could well be yours...



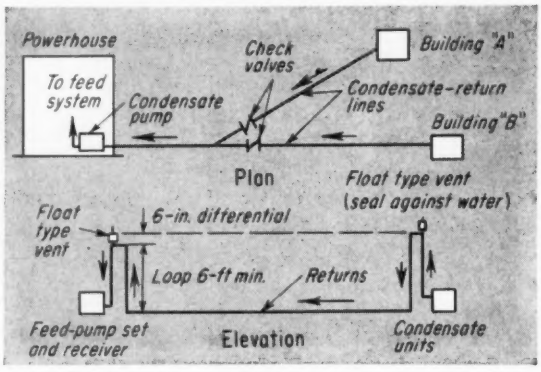
The problem

How can we improve our gravity condensate-return system?

Condensate from the heating system in many warehouses and office buildings is fed into condensate receiver tanks at each location. It's then pumped into common gravity-return lines leading back to the main condensate receiver at the powerhouse. Both steam and condensate lines run underground with manholes at each building.

Two separate branch lines, following the general run of the ground, slope toward the powerhouse and are joined in a Y connection some distance away. Condensate apparently collects at this point and comes back to the receiver in tremendous surges with an alarming amount of vibration. One suggestion is that we convert the return system to vacuum operation. Will this solve our problem? What is best way to improve our condensate system?—*JHS, December* POWER

The solutions



Loop seals improve performance

Installing a vacuum pump on the condensate-return system may work satisfactorily. If it's able to completely drain the return lines, surging and vibration will be eliminated. To keep any water pockets from forming we suggest using a hookup like the one above. The loop seal on either end will keep the return lines completely filled with condensate. Each time condensate flows into the system, an equal amount will flow out at the other end into the condensate receiver in the powerhouse.

It's also a good idea to install check valves on the two main condensate branches to prevent back flow.

H R KORNBLUM, *New York, N. Y.*

Carefully check pitch of return lines

We have about 200 acres full of high-vacuum return lines and would like to give you the benefit of our experience. It's simply amazing how much childlike faith people can have in the ability of a vacuum-return system to serve as a cure-all when any trouble develops. During construction of our system we protested in vain about the careless pitching of return lines. Many were badly back pitched. Veteran steam fitters and their supervisors said that it didn't matter because the vacuum system would pull the water through. Such was not the case and we ran into a lot of trouble.

Vacuum-return lines will not pull water uphill. They must be pitched uniformly, the same as any gravity return line. One inch per 100 ft is enough, but the pitch must be there. If you consider that the return line is only partially filled at all times you can easily see why a vacuum can't pull the water back from a low point.

Solution to our problem was an expensive regrading of the return lines. I do not suggest converting to a vacuum system without careful study. We finally used a transit to shoot the return lines. The results of this survey were

...Here's how Power readers would tackle them

BOB MARKS, Assistant Editor

carefully plotted on graph paper. This technique will give you the actual slope of the return lines in your system.

Apparently, focal point of your trouble is in the underground piping where the two lines join and enter the powerhouse. There probably isn't any practical way to check this pitch. But if it's excessive, the resulting high velocities will cause great turbulence at the Y as the two streams converge. If some back pitch is also present, air can be trapped and carried through in great slugs, accounting for the vibration.

Here is a possible solution which has the added merit of costing practically nothing. Each building has its own condensate receiver and pump. Receivers probably range in size from several hundred to several thousand gallons. The pumps, float operated, can usually empty the tanks in a very few minutes. So, intermittently, you have a large flow for a short period. If several pumps cut in at the same time the system receives a huge slug of condensate all at once.

Install an orifice plate in the discharge of each pump. Try one that's about one-fourth the size of the discharge line. This will reduce the instantaneous flow by making the pump operate for a longer period. Some experimenting will probably be needed to hit on the right orifice size. Another way is to hook up an ammeter and throttle the pump-discharge line until you see a drop in amperage. You should have the pump performance curves for this in order to make a precise adjustment.

By obtaining a steadier flow of condensate you will greatly improve your condensate system. Another important point: make certain that you have enough air-release valves at strategic locations in the return lines.

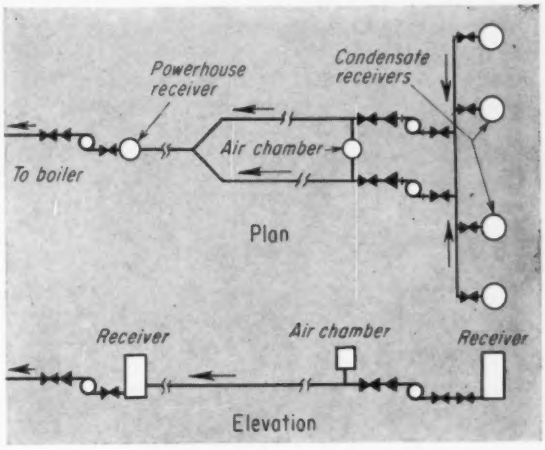
W J STEINERT, *Fresh Meadows, N. Y.*

Main return lines may be undersized

Surges and accompanying vibration and probably water hammer are caused by a combination of flashing and momentary high-flow rates. *JHS* doesn't say how much hydrostatic head is available from the outside receivers. But adding this to the pressure surges may mean that the powerhouse receiver is taking dangerously high pressures. This point should be carefully checked.

I suspect that the two branch mains are undersized. So install cross-connections or equalizers upstream of the Y connection to equalize line pressure. Next, install float controls or overhaul the existing ones to stop any blowing through individual receivers. Put a float valve on the condensate receiver to maintain something like a constant level. Use a pressure regulator to keep pressure level corresponding to saturation temperature at the individual condensate receivers.

R L NESBITT, *Holden, Mass.*



Air chamber helps control flow surges

It looks like *JHS's* trouble comes from water hammer caused by high condensate velocity at Y junction of the main return lines. One way to solve this problem is to install an air chamber, above, near the pumps or at a high point in the condensate system. This accessory controls pressure variations coming from rapid changes in flow. When flow rate increases, water level inside the chamber rises. Kinetic energy of the rejected flow is converted to potential energy inside the air chamber. This reduces magnitude of surges within the piping. During reduced flow rates, potential energy of the stored water is converted back into kinetic energy that helps fill the condensate receiver at other end of the line.

Since air is stored inside the chamber, compressed air must replace that dissolved in the water. Although water flow from the line into this chamber should be throttled, very little throttling is needed on the discharge line. Pipeline orifices will make these flow adjustments.

H B WAYNE, *Woodhaven, N. Y.*

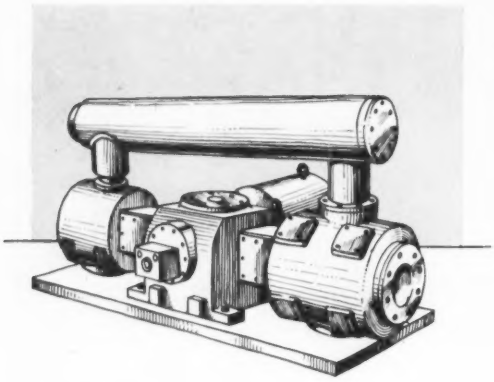
Vacuum system won't solve the problem

Installing a vacuum system is not the answer here. It will not stop condensate from collecting at the low point in the system. Same kind of trouble would continue and might even become worse. Simplest remedy is to install a small receiving tank with a float-controlled pump at the low point in the system. When water reaches the high level, pump sends it back to main condensate receiver. We use a system like this for three buildings.

L E POLIKOFF, *Bethpage, N. Y.*

Turn page for new problems ▶

More **plant problems**



The problem

What's wrong with the intercooler on our new 2-stage compressor?

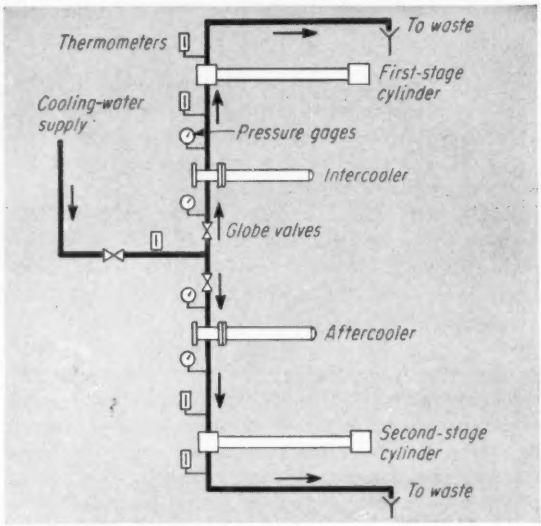
We have two new identical 4200-cfm 2-stage air compressors. Air intake for each is outside. Outlet air pressure is 105 psi at 75 F. Cooling water enters the intercooler at 70 to 75 F. It passes through heat-exchanger tubes and is raised about 15 F. On warm days with high humidity, we get about 10 gph from the intercooler trap and about the same amount from the aftercooler trap on machine No. 2.

But on machine No. 1 we only get about one pint of water per hour from the intercooler and 12 gph from the aftercooler with some water passing on to the receiver tank with the compressed air.

A new intercooler water separator was installed on this machine and the whole system checked. Pressures, temperatures, intercooler construction and location of air intakes are identical. How can we correct this trouble?—*CJZ, December* POWER

Want some help on plant problems? Send us any of your design and operating headaches. We'll put *Power* readers to work on them

The solutions



Try this 4-point cooling system check

Cooling-water system for a 2-stage compressor is shown above. Moisture separator and drain trap are usually installed at aftercooler outlet. This check list will help you spot some of the common sources of trouble.

(1) Check water temperature entering and leaving the inter and aftercoolers. (2) If temperatures are greatly different from design values, measure water flow rate to each exchanger. Check for partially closed valves that may be reducing cooling capability by throttling the flow. (3) Inspect inter and aftercoolers for plugging. Dirty surfaces or retarded water flow will reduce overall heat transfer. Pressure gages upstream and downstream of these units will indicate any excessive pressure losses. (4) Inspect separator and condensate trap. Faulty trap may be allowing condensate carryover. Dirt may prevent a tight seat.

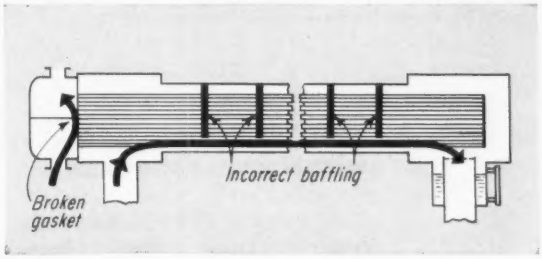
H B WAYNE, *Woodhaven, N. Y.*

Run heat balance on both machines

I suggest that *CJZ* first check the wet- and dry-bulb temperature at the inlet to machine during the time that he experiences the problem of no moisture separation at the intercooler of machine No. 1.

Second step is to run a complete heat balance on the two machines at the same time. It's important to do it simultaneously because ambient air temperature and relative humidity will vary if too much time elapses between tests on individual machines. It's my belief relative humidity of air entering each machine may be different. In that case it's entirely reasonable to expect one machine to remove more moisture than the other.

DON KELLAND, *New York, N. Y.*



Dismantle and inspect heat exchangers

I can imagine Marmaduke Surfaceblow snorting "BILGEWATER" as he puts his finger squarely on the answer to *CJZ's* problem. But we ordinary engineers will have to do it the hard way, step by step. Something has to be different. As a starter calibrate all gages and thermometers. I'd like to know the exact temperature of water and air entering and leaving the intercooler. It would also help to know the exact flow of water in gpm. Perhaps there is a partial stoppage of cooling water or there isn't enough available.

If a recheck of pressures and temperatures against design values doesn't give any clue to the trouble, some dismantling for inspection will be necessary. We had trouble some years back with baffle failure in the waterbox. Part of the water passed through the tubes, above, with an excessive temperature rise; remainder was bypassed. Strangely, temperature of the mixture leaving the exchanger was exactly normal and threw us off the track for quite a while.

We also had another unusual experience with a new heat exchanger that refused to work. After much fumbling we finally pulled the tube bundle and discovered the baffles were incorrectly installed. This allowed short-circuiting without any heat transfer at all. An embarrassed manufacturer sent us a new one, but we furnished all the sweat and tears. So don't take anything for granted in a new machine. Make sure that you:

(1) Calibrate all gages and thermometers. (2) Meter the flow of cooling water. (3) Remove the waterbox head and inspect all gaskets and baffles. (4) With the intercooler under pressure, listen at the waterbox for air leaks. (5) Prove that the water separator is working by admitting a measured quantity of water to the intercooler shell and measuring discharge from separator. (6) Make a thorough check of internal baffles. If enough coolant reaches adequate cooling surface the unit must work as designed.

W J STEINERT, *Fresh Meadows, N. Y.*

Air test intercooler for leaky tubes

It seems to me that *CJZ* has either a cracked tube, a tube or tubes with pinholes or a weeper (tube that is improperly rolled). The hole doesn't have to be large to leak 10 gph into the air side. We air test each tube by stopping both ends with expanding rubber plugs. Air is put into the tube at 15 psi through one plug. Then the air valve is closed. If pressure holds steady the tube is tight. If pressure drops the tube should be plugged or replaced. If all the tubes are tight the next step is to blank off the air inlet and outlet on the intercooler. Make sure the tube sheet is held tight against the intercooler shell and fill the air side with water. If tube is a weeper, water will show up on the surface of the tube sheet. Then replace or reroll the faulty tube.

H C BOSLEY, *Long Beach, Calif.*

Your March problems

Can condensate be used for cooling-tower makeup?

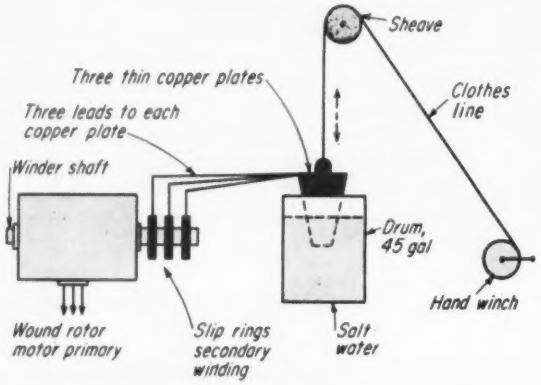
We operate a 2000-ton air-conditioning plant for a large office building. Refrigeration machines are centrifugal type with steam-turbine drive. Our steam is purchased from a public utility and delivered through a 150-psig supply line. In keeping with our policy of cutting down on both water waste and cost, we are considering the use of condensate for makeup water to the cooling towers. At present it's piped to a flash tank and then dumped to the sewer. Is there a possibility that the boiler-water treatment used by the utility will contaminate our recirculating water? I've been told that some plants don't treat their boiler water because the steam is used in company cafeterias for cooking. What experience have other readers had with condensate for this purpose? What are some of the problems involved in making this change?—*FJD*

How do you pick right capacity and type of steam trap?

We are installing a group of shop-built radiators consisting of cast-iron headers and wrought-iron pipe laterals. A typical radiator coil assembly contains about 350 ft of 1½-in. pipe. We estimate that 0.43 lb per hr of 20 psig steam will condense per lineal foot of pipe. Total condensate flow then becomes 350 (0.43) or 150.5 lb per hr. Our problem is to eliminate both air and condensate from each radiator. Does this service call for a trap with large air-handling capacity? If we use a safety factor of three, each trap must handle 450 lb per hr condensate. What capacity should the trap have? What types are best suited for this job? I'd like to hear how other POWER readers handle steam-trap selection in their plants.—*WA*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Timely practical ideas to help solve



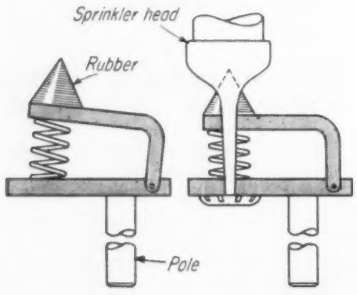
This jury-rig speed controller does the job

Rewinder motor on a paper machine was an ac slip-ring wound rotor motor. As you readers know, you must be able to control the speed on a winder. On most machines they are dc which are better for the job.

We had been working overtime trying to meet a deadline when we discovered that the resistance boxes for the winder motor had been broken beyond repair during shipment. The taps are brought out of these resistance boxes at different points and go to a drum controller, as sketch shows.

I took three pieces of 1/16-in. copper plate, then spaced and insulated the plates from each other with fiber spaces and fiber bolts. A 45-gallon drum was filled with water and salted until we got the desired control. A clothes line, an idler and a small hand winch made a perfect control. In fact, when the new resistances arrived and went into service, the papermakers preferred the rig I made.

L McWilliams, *Shawinigan, Que.*



Sprinkler closers replace protective covers

Since our plant is protected by sprinklers, there's always a chance that a sprinkler head may let go and flood an instrument or machine. Protective covers stored around the plant for such an emergency proved a problem as they gathered dust and were often taken away for other purposes.

Instead of covers we now use sprinkler closers attached to long poles. We use the unit shown in sketch, but others can be designed for specific sprinkler heads. Our unit consists of a rubber plug attached to a spring-loaded arm. The rubber cone seals the opening and the arm rests against the bottom of the sprinkler ring. A man gets wet when using it, but that was also true with covers.

W Martin, *Brooklyn, N. Y.*

Only one pump needed with bigger suction line

Plant with a 300-hp watertube boiler couldn't maintain required feedwater temperature. A deaerating feedwater heater had been installed. Normally this would have been a great help, but the suction line between the heater and duplex boiler-feed pumps was so small that water flashed at the pump suction inlet. This naturally called for a reduction in water temperature.

To solve the problem, cold water was introduced to lower the water temperature in the deaerating heater. At 180 or 185 F, the pump operated OK.

Suction-line size between heater and feed pump was 2½ in., had several fittings and was fairly long. Bottom of the feedwater heater was 14 ft 9 in. above the boiler-room floor, leaving a 14-ft head from bottom of heater to the pump's center line. Pressure measurement at the suction inlet to the pump showed a loss of 10 psi between the pump and heater. Obviously, if feedwater was carried at 220 F, there would be excessive flashing at the pump suction inlet.

To maintain the correct water level, the pump had to be operated at excessive speed. Under normal steam demands it would pound and jerk. This problem was solved by replacing the 2½-in. suction line between the heater and pump with a 4-in. line.

Raw-water supply. Required makeup water for the heater, over and above that returned as condensate, was supplied by three rotary pumps. Two pumps were always needed, the third at certain times. Pump discharge was 1¼ in. A small water softener and two sand filters connected in series to the pumps, and a line extended from the softener outlet to the feedwater heater.

Gage on the 1¼-in. header connecting the three pumps showed 80 psi. A gage near the outlet of the small water-conditioning unit showed

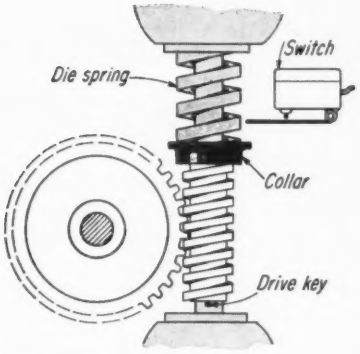
your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

10 psi with one pump running and 12 psi with all three pumps running. Originally each pump was directly connected to a 1-hp motor. But after two motor burnouts, each unit was equipped with a 2-hp motor.

We installed a 2-in. header and 2-in. discharge line from the pumps to the filters, water-conditioning unit and heater. This improved matters to extent that now only one pump supplies makeup water—and even it must bypass some of discharge to prevent heater from overflowing.

C T BAKER, *Atlanta, Ga.*



Spring stops shock

A heavy-duty worm drive on one of our machines gave us trouble with breakdowns due to shock and overloading. So we rearranged the drive as shown in sketch. First we freed the worm so it would slide on the drive key and shaft. Then we backed it up with a heavy die spring.

The die spring backs up against a collar which in turn backs up against the thrust bearing. This spring takes the shocks. When overloaded, the spring compresses until the collar strikes a switch wired in series with the coil in the motor starter. This cuts out the motor until the overload is corrected.

H KOSLOW, *Bronx, N. Y.*

EDITOR'S NOTE: *This is a fine example of how a little headwork can improve performance of a machine. Design engineers might do well to follow Mr Koslow's idea, shown above.*

What would you have done?

The spring-wound clock in the chief engineer's office of a South American plant began to lose time right after I had cleaned and oiled it. I was selected to repair it. But regardless of how many times I worked on that clock, it got into the habit of stopping every night around midnight.

First thing I was told when coming in for morning shift was that the clock had stopped again during the night. After a little brainwork, I came up with an answer.

Next night I dropped into the plant. Just as I thought, the clock had stopped. So I grabbed a flit gun, opened the clock without removing it from the wall and gave it a generous dose of flit. Then as I closed the clock she started ticking away merrily, much to the surprise of the night engineer.

My reasoning was simple. Last time I had cleaned her with gasoline I used turbine oil on each bearing. At night the temperature dropped enough to thicken the heavy oil. That would stop the clock. My flit-gun treatment thinned the oil and the clock started running.

That happened about 14 years ago. I wouldn't be surprised if it's still running. What would *you* have done?

C A VANDEURSEN, *Philadelphia, Pa.*

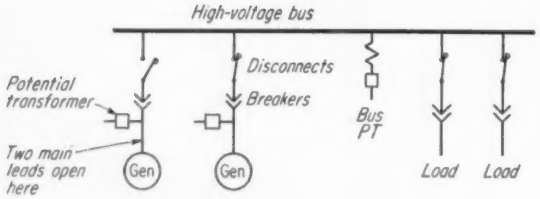
Watch those leaky compressor valves

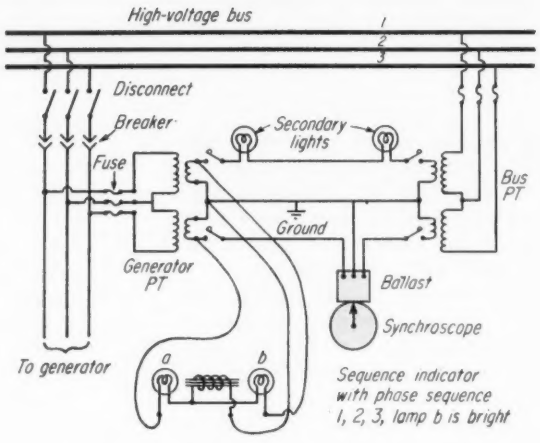
Leaky compressor discharge valves have given refrigeration-compressor-service and maintenance men a lot of trouble. They cause many motors to burn out. Reason: When the discharge valves are leaking and the suction valves are holding as the compressor starts, the full discharge pressure is on top of the piston at the *start* of its stroke. Obviously, the power needed to get the compressor started with the discharge pressure exerted on pistons is too much for the motor if it's not properly fused for this starting load. Then motor goes up in smoke. Here's why:

The compressor motor hums when trying to start. If properly fused it will blow the fuses. To diagnose, close compressor discharge valve and relieve pressure through gage port. With a valve screwed to the gage port, start the compressor and build up a head pressure (say 175 psi for Freon-12). Then close gage port valve on downstream side of pressure gage. If the discharge valves are leaking, pressure will drop right back down as soon as compressor is turned off.

This has led many to believe that a start winding of the motor has burned out. But they learn that the motor still won't start the compressor when winding is replaced. This is especially annoying when motor is a semihermetic job. Hope this idea will save someone a little time.

F E ZIEGELMANN, *Fullerton, Calif.*





Here's how we connect generators for parallel operation

Connecting generators for parallel operation may cause trouble and delay because many small plants have only one set of disconnects. My sketches may come in handy.

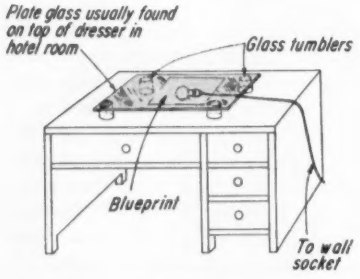
Permanent potential-transformer connections are made where shown. They must be rung out or made to coincide with bus potential transformers (PT) or with another unit, whichever system is being used. PT secondaries must be properly connected through switches and lights and a synchroscope or both. Leave the two main generator leads open as shown. Connect the phase-sequence indicator to the PT secondaries.

Close disconnects, breaker and synchronizing switches to this generator. With high-tension bus energized, carefully note phase rotation as indicated by sequence indicator. Compare voltmeter readings of this machine with others; they should be the same. Synchronizing equipment should indicate synchronous conditions—lamps dark, synchroscope stationary and indicating synchronism. If not, find and correct trouble before proceeding. Open breaker, disconnect and synchronizing switch. Connect generator leads previously left open but don't insulate permanently. Start generator and bring to near normal speed and voltage.

Check phase rotation and compare with previous indication. If rotation is same, shut down generator to insulate connections. If rotation is wrong these leads must be reversed and insulated permanently. Again bring generator to about normal speed and voltage. Phase sequence should now be correct and (sequence indicator) can be removed. Close synchronizing switches. Synchroscope needle should be revolving and respond directly as the throttle or governor is adjusted.

As speed is increased or decreased past synchronous speed, the needle or pointer should reverse and indicate the proper conditions, whether machine is fast or slow. Synchronizing lights should burn alternately bright and dim with each revolution of the synchroscope pointer. If all equipment has responded correctly the electrical connections are correct and the generator is ready to be synchronized and put on the line. Do you readers agree with me?

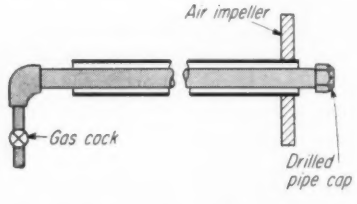
E G GARDINER, *Red Deer, Alberta*



Emergency blueprints

Have you ever wished you could make a quick copy of a blueprint shown at a week-end conference or show, but found all the shops closed? Sketch shows how job can be easily handled in your hotel room.

B A CROSSON, *Cranston, R. I.*



Prepare for light heating loads now

Now that heating season is ending are your boilers operating with burners too large for your load? You can solve that problem by tapping off between the Mason valve and the main burner cock with a ¾-in. line to a small improvised burner, sketch.

In our plant, the 1¼-in. pipe-cap had to be ground down to fit the oil-burner passage. Nine 3/32-in. holes were drilled at 20-deg angles to the sides. We find that this burner gives a good oil-gas mixture as well as flame failure protection.

It's inefficient to use burners that are too large for load. Heating surfaces get sooty, cause trouble.

K R MCCORMICK, *Edmonton, Alberta*

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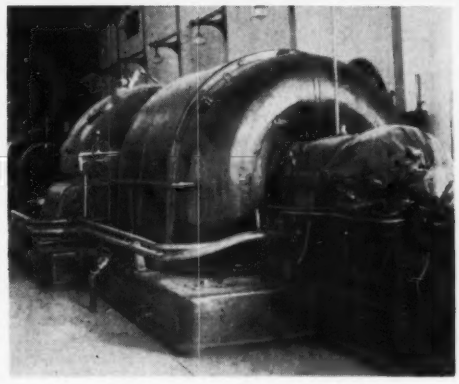


Write for complete specifications and prints

2—12,500 KW ALLIS CHALMERS TURBO GENERS. 275PSI 610°F
2—16,000 SQ. FT. WESTINGHOUSE SURFACE CONDENSERS
1—500 KW G.E. NON COND. TURBO GENER. 265PSI; 0-10#BP
1—60 KW TERRY NON COND. TURBO GENER. 250PSI; 15#BP
3—1,296 HP B&W SEC. HEADER BOILERS 275PSI; GAS/OIL
2—1,500 KVA 3 PHASE G.E. TRANSFORMERS 34,500-460V
1—40 TON OET CRANE, 10 TON AUX.; 47' SPAN; 75' LIFT; CAB OPERATED.
1—MARLEY 3-24E 1 COOLING TOWER 20,000 GPM
1—8" MORRIS DREDGE PUMP WITH 75HP MOTOR
2—24" CENTRIF. PUMPS 20,000 GPM @ 60'; 400 HP MOTORS

TURBO-GENERATORS

2500KVA Auto Extraction Non Cond. 600PSI 650°; 160PSI Extraction; 30 PSI BP; 3/60/480V.
1875KVA Condensing 400PSI 700°F with Surface Condenser 3/60/2300V.
500KW Condensing 200PSI A.C. or D.C.

TRANSFORMERS

6000KVA Sub-Station 3/60/44000-4160
3—2000KVA Furnace 13,200-120 1ph.
3—500KVA 66000-460 Single phase
3—75KVA 4600-115/230 Single phase
2—50KVA 440-120/240 Single phase

PUMPS

Vertical

2600 GPM @ 173'—200 HP
1500 GPM @ 150'—125 HP
680 GPM @ 150'— 40 HP

Horizontal

20,000 GPM @ 60'—400 HP (2)
1,325 GPM @ 60'— 40 HP
50 GPM @ 1200'— 40 HP

MOTORS

Vertical Hollow Shaft

200 HP G.E. 1800 Explosion Proof
125 HP G.E. 1800 Explosion Proof
40 HP G.E. 1800 Expolsion Proof
40 HP G.E. 3600 Drip Proof (6)
30 HP G.E. 3600 Drip Proof (2)

Horizontal

400 HP West. 720 Slip Ring (2)
150 HP 900 Gen. Elec. TEFC
150 HP West. 1800 Slip Ring
75 HP West. 1800 Slip Ring (2)
50 HP Gen. Elec. 1800/900 X.P. (2)
50 HP 1800 Allis Chalmers
30 HP West. 1200 Slip Ring (2)

GAS ENGINE GENERATORS

11—1250 KVA Natural Gas Engine, 8 Cylinder, 4 Cycle, 3/60/2400-4160. Complete with panel board and Switchboard.

(Inspection in Operation.)

MISCELLANEOUS

540 KVA 3/60/460 Capacitor
500 KW 120/240V 1200RPM D.C. Westinghouse Generator
600 Amp General Electric FK0227-50 Oil Breakers (2)
1350 CFM Nash #7 Vacuum Pumps (2)
90 CFM Nash #1 Vacuum Pump
25 Ton Northern Crane 36' Span
Worth. Deaer. Heater 35,000#/hr.
Elliott Deaer. Heater 170,000#/hr.
8" Morris Dredge Pump 75 HP
2000 sq. ft. West. Surface Condenser
67.6 sq. ft. Grate Area C.E. Stokers (8)

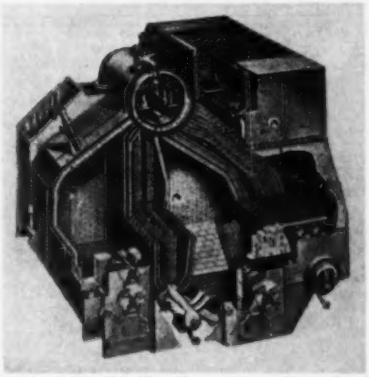
(2) All Steel Buildings 50' wide, 200' long, 60' under Truss; Corrugated Transite Sides and Roof—will be dismantled and match marked for re-erection.

104"x70' Coal Dryers Double Shell (4)
Worth. Deaer. Heaters 30,000#/hr (2)
7'x50' Coal Dryer Double Shell
Coal Crushers & Hammermills (15)
Bucket Elev. 45' to 90' C/C—for Coal (8)
Hot Water Storage Heaters 40"x8' (2)
50,000 gal. Water Tower 100' high
Apron Feeders for Coal—18"to 48" (15)
Belt Conveyors for Coal 16" to 24"—10,000'

MOTOR GENERATOR SETS

1250KW 4400-170/40 West. Synch.
500KW 4160-125 G.E. Synch.
200KW 2300-250 Al. Ch. Synch.
30KW 440-125 Louis Allis

NEW UNASSEMBLED STEAM BOILERS (12)



B&W, F.W., C.E. Two Drum Water Tube, Steel Encased with Superheater, Economizer, Soot Blowers, Fuel Oil Burners, Valves and Fittings. Rated as follows:

# Steam/hr	Pressure	Superheat
122,500	565	850°F
60,000	435	750°F
44,500	450	735°F
35,000	285	577°F

BOILERS

75,000#/hr 650PSI 650°F Oil fired C.E.
25,000#/hr 450PSI 738°F Stirling Stoker Fired
200 HP 160PSI Keeler, Stoker Fired

HEAT & POWER CO. inc.

POWER EQUIPMENT DIV.

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Thousands of new and "Certified Rebuilt" Motors & Generators in stock—up to 1000 H.P. OUR 53rd YEAR

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
700	Whse.	Slipring	2300/4000	1200
600	Elliott (2)	Sq. Cage	2300	900
500	Allis Ch.	Slipring	2300/440	600
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	Whse.	Sq. Cage	2300	900
400	G.E.	Slipring	2300	514
350	Br. Boveri b.b.	Sq. Cage	4800/480	720
350	G.E.	Sq. Cage	2200	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
350	G.E.	Slipring	220/440	900
300	G.E.	Slipring	2200/440	600
300	G.E. (2)	Synch.	2200/440	360
300	Whse.	Slipring	2300	514
300	Whse.	Synch.	440	1200
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Sq. Cage	2200	1800
250	Whse.	Sq. Cage	2300/440	600
200	G.E.	Slipring	440	600
200	L.A. TEFC	Sq. Cage	440	1200
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2200/440	720
200	Whse.	Sq. Cage	2200/440	900
150	Rel TEFC	Sq. Cage	220/440	900
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E. (2)	Sq. Cage	2200.440	1800
150	Whse.	Slipring	220/440	1200
150	G.E.	Sq. Cage	2300	900
125	F.M. b.b. (2)	Sq. Cage	220/440	1800
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. T.E.F.C.	Sq. Cage	2200	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	900
125	Whse. T.E.F.C.	Sq. Cage	2300	900
75	G.E. b.b. (8)	Sq. Cage	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	RC	250	1450
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	650
100	Reliance b.b.	385-T	250	1500
75	Gen. Elec.	CD-123	125/250	1200
75	Whse. b.b.	SK-123L	250	1800
60	Ideal	D	125	1150
60	Reliance b.b.	262-T	250	1200
40	Reliance b.b.	230-T	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
200	Whse. b.b.	SK	250	287/575
150	Whse.	SK-184	230	850
150	Whse.	SK-210	230	320/1000
150	G.E. b.b. dyn.	TLC-50	250	1750/3500
125	G.E.	CD-172	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
75	Whse.	SK-163	230	850
75	Whse. (4)	SK-163	230	500/1500
60	G.E. TEFC b.b.	CD-135	230	1150
50	Century	DN-514	220	1150/1750
50	G.E.	RF-16	230	250/1000
40	Whse. b.b. (2)	SK-163	230	300/1200
25	Whse. (2)	SK-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	Whse. (2)	2200/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	Gen. Elec.	220/440 AC	250 DC
75	Star b.b.	220/440 AC	250 DC
75	G.E.	200/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	G.E. b.b. (3)	220/440 AC	250 DC
40	Ideal	220/440 AC	250 DC

Arthur Wagner Co. Certified

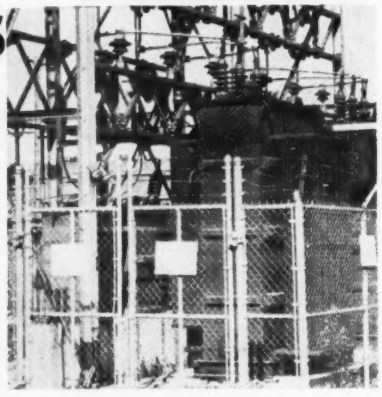
MO nroe 6-7409

1435 W. RANDOLPH ST

CHICAGO 7, ILLINOIS

AAA OFFERS FOR SALE

5,000 KVA Sub station



Perfect Condition in Every Respect

Available at Thousands Below Original 1956 Cost

Complete 5000 KVA Substation 23 KV—4.16KV Consisting of Outdoor Aluminum Structure with Porcelain Insulated 23 KV Aluminum Bus.

Two Positions for Incoming 23 KV. circuits with manual group operated disconnect switches and Size 5 fuses for power circuit protection.

Two Sets of Size 4 fused disconnects for potential transformer protection.

6—25000—125/250V. 10 KVA 1 phase Transformers used as potential transformers for relaying. (Wagner Electric)

2—2500 KVA 22.9 KV, 23,000 Primary—2400/4160 T 3 phase 60 cycle OISC transformers with primary cover bushings and secondary junction boxes Type HPW-26. (Wagner Electric)

1—Set of 4160 volt switchgear consisting of 2—600 amp. 4.16 KV. 50 MVA drawout air breaks complete with overcurrent relays and ammeter for bank protection connected to common bus with provision for Power Company metering and cable entrance for connection to 4.16 KV load. Complete set of power directional and ground relaying for protection with supply from 2-23 KV power sources. (ITE)

1—Set of 3 R&I.E. type LB 400 amp. 5 KV load break interrupter switches with common 5 KV supply bus.

AAA MACHINERY & EQUIPMENT CO.

INSPECT ON LOCATION: ALCOA-BUFFALO WORKS,

1880 ELMWOOD AVE., BUFFALO, N. Y. — CALL Riverside 0645

ELECTRICAL POWER EQUIPMENT

A. C. MOTORS—3 ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT-6	6600	1187
1	800	Whse.	CW	550	1776
1	700	Al. Ch.	D.P.	2300	500
1	600	Whse.	CW-432D-15	440	1778
1	500	Whse.	CW	550	350
1	350	Cr. Wh.	SIZE-718R	203/406	1763
1	350	G.E.	IM-17A	440/2200	720
1	350	Whse.	CW-1039C	440	720
1	250	G.E.	MT-424Y	4000	257
1	250	Cr. Wh.	SIZE-290	2300	350
1	250	A.C.		550	600
1	250	G.E.	MT-563Y	440	875
1	250	Whse.	CW-1010	2200	435
1	200	Whse.	CW-874D	220	885
1	200	G.E.	IE-13B	220	1760
1	200	G.E.	IM	2200	580
1	200	G.E.	IM	2200	435
2	200	Whse.	CW-890	2300	1775
1	125	G.E.	MT-557Z	220/440	1200

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
1	500	G.E.	FT-559AY	2300	3600
1	550	Whse.	CS-1115	2300	900
4	500	Whse.	CS-1216	2200	500
3	500	G.E.	KF	2300	3600
2	450	Whse.	CS-1420	2300/4150	354
2	400	Whse.	CS-7151-610H	6600/4000	3565
1	400	G.E.	IK	2200	500
1	300	Whse.	CS-1002	2300	600
1	200	Whse.	CS-963H	2300	1175/878
1	200	G.E.	KT-557	440	1800
2	200	Whse.	CS-855S	220/440	1750
1	150	G.E.	CS	440	530

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-8L	13800/6900	514
1	3500	G.E.	TS-6438P	2300/4000	360
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4600
1	2000	G.E.	514	600	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1200	West.	720	600	2300/4160
1	1000	G.E.	900	260	6600
1	750	G.E.	720	275	6600/13200
1	500	Whse.	900	125/250	440
1	350	G.E.	900	125	440/2300/4150
2	300	G.E.	1200	250	2300
1	250	G.E.	900	250	220/440
1	240	West.	900	125	220/440
1	200	El. Mhy	1200	250	2300/4600
1	300	Whse.	1200	600	2300
1	200	Whse.		550	2300
1	200	Cr. Wh.	1200	250	440
1	150	Whse.	1200	275	2300
1	100	G.E.	1200	250	4160/2400

TURBO GENERATORS

Qu.	KW	Make	Desc.
2	300	G.E.	175/200# Cond. 480/2300 V.
1	1000	G.E.	150# no Cond 2400 V.
1	4000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
3	3333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	FUR	1	4800x35/55
3	500	KUHL	OISC	1	13600x6000
1	225	Marcus	Air	3	auto 208/220
3	100	G.E.	OISC	1	4800/8325Yx120/240
3	100	L.M.			
3	100	L.M.	OISC	1	4160/7200Y/240/480

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
3	6750	G.E.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
2	2500	G.E.	25 cy/62.5	2300/2300
1	500	Al. Ch.	25/60	11000/2300
1	200	G.E.	60/3000	440/880

COMBINATION MILL DRIVES—
D.C. MOTORS WITH M.G. SETS & CONTROLS
PACKAGE DRIVES IN STOCK

1—2250 HP Elliott 230 V. 200/300 RPM DC Motor with 2400 KW GE MG Set. 300 V. DC 2300/4600 V. 450 RPM 3 ph. 6 0cy.

1—1375 H.P. G.E. MCF, 415 V. 1300 RPM D.C. motor with 1100 KW G.E. MG Set 415 V DC, 2300/4000 V. 720 RPM 3 ph. 60 cycle.

1—1300 HP G.E. MPC 600 V. D.C. Motor, 450 RPM, and 1000 KW. G.E. M-G Set, 600 volt DC with 1400 KP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

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Oldest Shipbreaking Firm in the U.S.A.

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BATTLESHIP U.S.S. KENTUCKY

Equipment installed but never used — all built to Navy standards of finest materials

TREMENDOUS SAVINGS ON ALL POWER EQUIPMENT!

PUMPS

10 MAIN FEED PUMPS

PUMP: Ingersoll-Rand — size 5" — three stage — capacity 500 GPM @ 750# discharge pressure. B.H.P 330 — 5000 RPM. *TURBINE:* Worthington-Moore — design pressure 575#/sq. inch — non-condensing — back pressure 20# — 5000 RPM — 330 B.H.P.

GEARED TURBINE-DRIVEN MAIN FEED BOOSTER PUMPS

PUMP: Mfg. by Buffalo Pump Co. — vertical single stage — capacity 550 GPM — 30# discharge — 8" suction — 5" discharge. *TURBINE:* 1 stage impulse — type Y-W — vertical — design steam pressure 575# — back pressure 20# — 12.5 HP — 5500/1750 RPM — mfg by Terry Steam Turbine Co.

2 MAIN FEED BOOSTER PUMPS

Same as geared turbine driven main feed booster pumps above, but with 14.5 HP 440/3/60 AC Star motor & Ward Leonard control. Across-the-line starter with pushbutton.

8 GEARED TURBINE-DRIVEN VERTICAL CONDENSATE PUMPS

PUMP: Main condensate 2-stage vertical pump — mfg by Buffalo Pump Co. *Capacity:* 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM — 22.5 BHP — 9" suction — 4" discharge. *TURBINE:* Single stage — 575# working pressure — 20#/sq. inch back pressure — 22.5 HP — 5360/1150 RPM — Mfg. by Terry Turbine Co.

2 AUX. FEED BOOSTER PUMPS

PUMP: Vertical — mfg by Buffalo Pump Co. — 200 GPM — 30# discharge pressure. *MOTOR:* 7.36 HP — 1800 RPM — 440/3/60 — Star motor, with control.

BRONZE RECIPROCATING STANDBY FEED PUMPS

11 x 8 x 18 — mfg by M. T. Davidson Co. — vertical simplex — capacity 180 GPM — 800/900# discharge pressure — 575# working pressure.

4 TURBINE-DRIVEN FIRE AND FLUSHING SERVICE PUMPS

PUMP: Worthington — horizontal centrifugal. *Fire Service:* 750 GPM capacity — 150 PSI discharge pressure — 3500 RPM. *TURBINE:* single impulse — type B-20 — mfg by B. F. Sturtevant — design steam pressure 575# per sq. inch non-condensing. Back pressure 15# — B.H.P. 80/90.

3 GEARED TURBINE-DRIVEN MAIN CIRCULATING PUMPS

PUMP: Mfg. by Worthington Pump & Machinery Co. — 28" type — vertical single stage — bronze. *Capacity:* 28,000 GPM — discharge pressure 13.5# — 600 RPM — 267 BHP — 28" suction — 28" discharge — 8.5:1 gear ratio. *TURBINE:* single impulse — vertical type — 575# design steam pressure non-condensing — back pressure 15#/sq. inch. RPM 5100 pinion — 600 gear. Reduction gear ratio 8.5:1 — 267 BHP — mfg by B. F. Sturtevant.

3 MOTOR DRIVEN MAIN CONDENSATE PUMPS

Mfg. by Buffalo Pump Co. — vertical 2-stage — 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM. *Motor Data:* 25 HP — 440/3/60 — 1150 RPM — Star Electric Motor Co. — with across-the-line starter, with pushbutton station — mfg by Ward Leonard.

8 GEARED TURBINE-DRIVEN MAIN LUBE OIL PUMPS

Mfg. by Northern Pump Co. *PUMP:* Vertical rotary type — 750 GPM — 55#/sq. inch discharge pressure — 263 RPM — 35 BHP — oil viscosity 130 to 500 S.S.U. — 7" suction — 6" discharge. *TURBINE:* Single stage — 575# design pressure non-condensing — exhaust pressure 15# — 35 BHP — 26.39:1 gear ratio — 6940 RPM.

4 TURBINE-DRIVEN GEARED FUEL OIL BOOSTER PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 300 GPM — 150# discharge pressure — 282 RPM — 47.3 BHP — Oil viscosity 70-700 S.S.U. — 7" suction — 5" discharge. *DRIVE:* single stage impulse — 575# non-condensing — 15#/sq. inch discharge pressure.

6 FUEL OIL SERVICE PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 85 GPM — 350# discharge pressure — 560 RPM — 27.4 BHP. *TURBINE:* 1 stage — 575# non-condensing — exhaust pressure 15# — mfg. by Northern.

VALVES

THESE ARE JUST A FEW OF THE MANY VALVES OFFERED. ALL TYPES ARE AVAILABLE INCLUDING REDUCING—SENTINEL—RELIEF—MICROMETER—PRESSURE REGULATING — ANGLE, ETC! STEEL—600# SERVICE—SEND US YOUR REQUIREMENTS FOR QUOTATIONS

LESLIE 2" GOVERNOR VALVES

Type C.P. — class A — capacity 7640#/hr. — 575# steam pressure — 750# discharge pressure.

MOTOR OPERATED GATE VALVES

Low Pressure — comp. geared — 38" — mfg by Chapman Valve Co. *MOTOR DATA:* H.P. 18 ft. lbs. running torque — 45 ft. lbs. max. starting torque — 440 volts 900 RPM 3 phase 60 cycle. Type: Submersible Valve Brake — Motor: Star Electric Co.
Also available, same as listed, but 36", and 28" inch as listed, but with smaller motor.

MISCELLANEOUS

AIR COMPRESSORS AND BLOWERS

18 WIDE RANGE FORCED DRAFT TURBINE-DRIVEN BLOWERS

9 R.H. — 9 L.H. — mfg by B. F. Sturtevant — propeller fan type — capacity 29,500 CFM/5540 RPM/250 BHP — 8250# steam/hr. — and, 9,000 CFM/1985 RPM/9 BHP — 690# steam/hr. — 7 blades — static: max 35" water — normal 21.5" water. Driven by Sturtevant turbine type VC-7 — non-condensing — single stage — 250 HP — 575# steam pressure — 15# PSIG exhaust pressure.

2 HIGH PRESSURE AIR COMPRESSORS, MOTOR DRIVEN THROUGH REDUCTION GEAR

Mfg. by Hardie Tyne — vertical reciprocating type — single acting — 30 cu. ft. @ 3000# discharge pressure — 4 stage — bore 7¾ x 6½ x 2 31/32 x 1½ — stroke 6" — 3 intercoolers — 450 RPM. *MOTOR:* 75 HP — 440/3/60 — 3550 RPM — frame 441 — mfg by GE — class High Shock.

2 LOW PRESSURE AIR COMPRESSORS

Mfg. by Gardner-Denver — vertical tpye — 101 CFM @ 100# discharge pressure — 2 stages — 5¾ x 4¾ bore — 5" stroke — 870 RPM — 25 BHP. *MOTOR:* 28.6 HP — 900 RPM (sync) — 440/3/60 — mfg by Diehl — with Cutler-Hammer control.

LUBE OIL COOLERS

4 — mfg by Westinghouse. 1600 sq. ft. cooling surface — cylindrical straight-tube horizontal type. Oil capacity 590 GPM — water capacity 1500 GPM — temp. oil inlet 150°F — outlet 120°F — temp. water inlet — 85°F — outlet 90°F. Number of ⅝" tubes 816 — Wall 0.049 TK — Cupro-Nickel.

MAIN CONDENSERS

Mfg. by Foster-Wheeler — 23,500 sq. ft. cooling surface — 40,500 GPM circulating water — total tubes 8,976, of cupro-nickel, as follows: (550) each ⅝" x 0.066 and (8416) each ⅝" x 0.049. Monel water boxes.

BOILERS

7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity:* 210,000 lb. steam/hr. Ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters.

3 GLAND EXHAUST CONDENSERS

Foster-Wheeler — total capacity lbs./hr.: 1200 lbs. steam and 350 lbs. air — 155 sq. ft. — 4" ejector.

LARGE DEAERATING FEED HEATERS

Monel construction — spray type — capacity 480,000 lbs./hr. — vertical condenser — single pass — heating surface 174 sq. ft.

GE HIGH AND LOW PRESSURE MAIN PROPELLING TURBINES

WILL SELL SEPARATELY FOR TESTING, WIND TUNNEL OR SIMILAR WORK. *(2) High pressure* — 24,400 HP — 12 impulse stages — 4909 RPM — working pressure 540# — 825°F. *(2) Low Pressure:* 28,600 HP — 3913 RPM — working pressure 49# steam — 424°F — 2-6 stages of impulse.

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MISS POWER EQUIPMENT SAYS,

"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed New and Rebuilt Motors"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
500	L.A. B.B. Splash. 440 Volt	FX-1465	3600
500	G.E. S.B. Open	IK	1200
400	L.A. B.B. Splash		1800
400	G.E. S.B. Open	IK	1200
400	West. S.B. Open	CS	900
400	West. S.B. Splash 2800 Volt	CS-39B	720
300	G.E. S.B. Open	IK	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	West. S.B. Open	CS-1002	600
300	Reliance. B.B. Splash	AA-8085	600
250	G.E. S.B. Open	KT	1800
250	L.A. B.B. Drip.	OGX-117	1800
250	G.E. S.B. Open 2200 v	IK-16	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	Cont. T.E.F.C.B.B.	NP-686C	1800
200	West. S.B. Open	CS	1200
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-15S	1200
200	G.E. S.B. Open 2200 v	IK	1200
200	L.A. B.B. Drip.		1200
200	G.E. S.B. Open	IK	900
150	West. TEFCBB XP	CS-773.6	3600
150	G.E. TEFCBB	KI6328	3600
150	G.E. TEFCB XP	K	3600
150	Wst. S.S.B. Opn	CS-761C	1800
150	G.E. TEBB	K	1800
150	West. S.B. Open 220V	CS	1800
150	G.E. S.B. Open	IK	1800
150	Marathon. B.B. Drip	TDA-584	1800
150	G.E. B.B. Open	KT	1200
150	G.E. S.B. Open	IK	900
150	Cont. T.E.F.C. B.B. New		900
150	G.E. B.B. Open	KT-558	900
150	G.E. S.B. Open	KT-558	900
150	G.E. S.B. Open	IK	720
125	G.E. TEFCBB	K	3600
125	A.C. B.B. Open	ARX-505	3600
125	West. S.S.B. Open New	CS-607	1800
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open	CS	1800
125	G.E. S.B. Open	KT-553	1200
125	G.E. S.B. Open	IK	1200
125	G.E. S.B. Open	IK	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
125	West. B.B. Open	CS-874C	600
100	Howell T.E.F.C.B.B.	K-505	3600
100	G.E. B.B. Drip	K-504	3600
100	G.E. S.B. Open	KT-343	1800
100	G.E. B.B. Open	K-504	1800
100	El. Dyn. T.E.F.C.B.B. XP	KNX-223	1800
100	L.A. T.E.F.C.B.B.	JX-113	1800
100	G.E. S.B. Open	KT-347	1200
100	West. SSB Open	CS-607	1200
100	Wagner T.E.F.C.B.B.	CP-635	1200
100	Reliance B.B. Drip.	AA-5084	1200
100	G.E. S.B. Open	KT-356	900

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POWER EQUIPMENT CO.

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TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/2400
2	750	G.E.	K	1	4600-120/240
1	750	Niagara	Air Cooled	3	2400/4160-480/277
1	300	Penna.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/3820Y/120/240
2	250	West.		1	2300/4600-230/460
3	200	Al.-Ch.	CBS	1	2400/4160Y-240/480
3	200	G.E.	H	1	7800-15600-220/440
1	150	Eisler	OA	1	4160-240/480
3	100	G.E.	H		2400/4160-240/480
1	50	G.E.	Air Cooled	1	440/220-220/110
3	50	G.E.	HS	1	2400/4160-240/120
1	50	Amer.	Westol	3	4160-120/208Y
5	50	G.E.	HS	1	2400/4160-240/480
4	25	West.	Hyperail	1	2400/4160-120/240

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
3	60	E.M.	1200	125	220 v. Syn.
1	75	G.E.	1200	125	2300/4160 Syn.
2	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y SR
1	500	G.E.	1200	250	440 Syn.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Westghe 3/60/480—1200

1—Wisconsin Gas (Air) PE-99 7.5 KVA Master 1 or 3/120—2200 r.p.m.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	690	CW	220/440
1	60	G.E.	1800	MT	220
1	75	G.E.	600	IM	440
1	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	450	MT	2200
1	500	G.E.	1200	M569Z	2300/4160Y

D.C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	75	Star	1200	SB 60 L B.B.
1	92	West.	425/1000	173 FR
1	350	G.E.	1200	Pedestal

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—275 HP, 1180 RPM G.E. Type KT 559BS 2200V
2—200 HP, 1790 RPM, G.E. Elec. KF, TEFC, 2300V
1— 40 HP, 1750 RPM Wagner 444 440V T.E.F.C.
3— 25 HP, 1170 Howell 405 440V T.E.F.C.

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

100 HP 900 RPM G.E. Fom BL 2200 V.
125 HP 600 RPM G.E. Type TS 2200 V.
125 HP 900 RPM G.E. Type TS 4800 V.
150 HP 1800 RPM G.E. Type TS 220 V.
325 HP 900 RPM West—2300 V.
300 HP 720 RPM Elec. Machinery t.e.f.c. 2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.

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1603 54th STREET, NORTH BERGEN, N. J.
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BOILERS

PACKAGE TYPE

15 HP Kane 100 PSI, Gas Fired, Fully Automatic, 1953
20 HP Cleaver Brooks, 125 psi, Fully Automatic, #2 oil
40 HP Cleaver Brooks, 15 psi, Fully Automatic, # oil, 1949
50 HP Cleaver Brooks, 125 psi, Fully Automatic, #2 oil, 1951
90 HP Cyclotherm, 125 psi, Fully Automatic, #2 oil, 1946
125 HP Cleaver Brooks, 125 psi, Fully Automatic, #2 or #4 oil, 1948
250 HP Dutton, 150 psi, Fully Automatic, #6 oil, 1953
250 HP Superior, 125 psi, Fully Automatic, #6 oil, 1947
400 HP Preferred Utilities, 150 psi, Fully Automatic, #6 oil, 1949
100-150 HP Titusville Scotch Marine, 200 psi, #2 oil, 1950

WATER TUBE

1—Keeler CP Type, 310 HP, 160 psi, 1945, located Florida
1—B&W FF Type, 310 HP, 160 psi, 1945, located Florida
1—International, 150 HP, 125 psi, 1945, Located Upper N.Y.
3—600 HP B&W Sectional Header, 425 psi, Located Upper N.Y.
1—800 HP B&W Sectional Header, 200 psi, Located Upper N.Y.
6—812 HP B&W Sectional Header, 200 psi, Located N.J. local
3—1300 HP B&W Sectional Header, 275 psi, Located Western States.

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2 500 K.V.A. Steam Generator Turbines. Size 502 BLL. 3/60/7200 volts. De Laval Steam — 541 H.P. — 185 lbs. pressure.
1 187 K.V.A. Steam Generator Turbine. Size 253 BL6. 3/60/7200 volts. De Laval Steam — 210 H.P. — 185 lbs. pressure.
4 Westinghouse Transformers — 333 K.V.A. 60 cycle. Single Phase 7200—6000—230—115. Type SK.
6 Westinghouse Transformers—7½ K.V.A. 60 cycle. Single Phase 16,000—8,000—230—115 volts.
1 Allis Chalmers Transformer — 333 K.V.A. 60 cycle. Single Phase 7,200—6,000—230—115 volts.

oil switches, board and miscellaneous equipment included with the purchase of these items.

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WORLD'S BEST REBUILTS

70 CFM 1500 psi 9x8 Norwalk TDS3T
100 CFM 125 psi 6x7 Ing. ES1
138 CFM 100 psi 7x7 Ing. ES-1
140 CFM 3500 psi 12¼x10 Norwalk TRS4T
162 CFM 120-500 psi 7½x13 Worth, St Booster
191 CFM 300 psi 9-4¼x9 CP TB2
238 CFM 100 psi 9x9 Worth. H. B. Ing ES
268 CFM 500 psi 10-4¼x10 Ing.
311 CFM 1500 psi 10½-7½-3½x13 Ing. ES3
465 CFM 100 psi 12x11 Ing.
502 CFM 125 psi 12x13 Worth. H.B.
585 CFM 100 psi 15-9¼x12 Ing. XRE 3-60-4160
628 CFM 100 psi 14x13 Ing ES
676 CFM 100 psi 15-9¼x12 Ing. XRB
868 CFM 125 psi 18-8x7 Jay WNI02 150 HP
920 CFM 110 psi 18-11x12 CP-OCE
7950 CFM 200 psi 33-17¾x27 IR PRE2 4C 1750 HP 3-60-2300

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Dell Ave. & 47th St. North Bergen, N. J.
UNion 5-4848

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3000 KW GE CURTIS. CONDENSING. 365# ISP. 200° FS 3/60/2300 VOLTS. NEW 1930. FULL AUXILIARIES. BARGAIN.

1666 HP BUSCH SULZER DIESEL. 8 CYL. 200 RPM. 1563 KVA WESTGHS. 3/60/2400 V. NEW 1938. FULL AUXILIARIES. EXCELLENT. REAL BARGAIN.

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525 & 600 HP Sectional Header Boilers
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32,000 CFM Motor Driven Blower
100 HP BB Late Type Motor w/starter
H. & P., 6719 Etzel, St. Louis 14, Mo.

TRANSFORMER BANK

3—1000 KVA—General Electric—Type H, Form VDM, Single Phase, 13,200v. Pri.-W/4-2½% Taps below, 2300/4000Y Sec. Serial #7,024,377-78-79.

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400 lb. Pressure 750°
G.E. Turbine Generator
Condensing - Automatic Extraction

2500 KW @ 70% P.F.
Condensing 28" Vacuum
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25 PSIG
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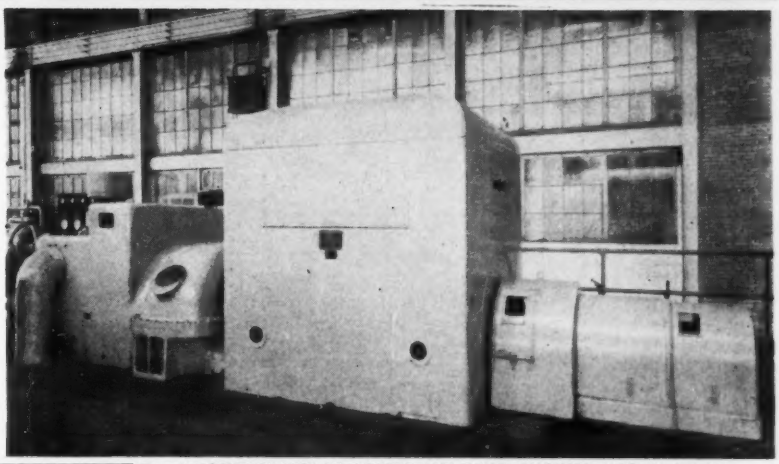

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300 KW G.E. Non-C Turbo Generator
3/60/480—150# 5-10# BP 3600 RPM

2000 KW GE N.C. Ext. Turbo-Gen.
480V, 600# 650° 150# Ext 30# B.P.

3000 KW GE Condensing Turbo-Gen.
2400/4150V, 400#, 725°, 3600 RPM

45000# Combustion Engineering BOILER
450# 750°TT, oil fired

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50 Church Street, New York 7, N. Y.

1—Union Iron Works, 100,000#—250 psi
3—Babcock & Wilcox, 100,000#—713 psi
1—Riley, 70,000#—290 psi
2—Union Iron Works, 40,000#—250 psi
12—Babcock & Wilcox sect. header boilers
1—Elliott deaerating heater, 220,000# hr.
5—Riley #4 Attrita coal pulverizers

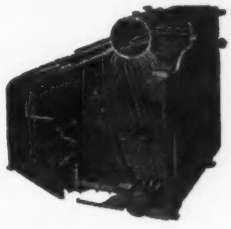
Non-condensing turbo generators

1—Terry 400 kw, 3/60/480
2—Allis-Chalmers, 500 kw, 3/60/480
1—Allis-Chalmers, 1000 kw, 3/60/480
4—General Electric, 3375 kw, 3/60/2400

Midwest Boiler & Turbine Co.
520 - 5th Avenue
New York 36, N.Y.

BOILERS

NEW UNASSEMBLED



# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

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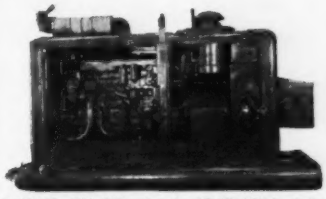
315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE 2-4513

COMPLETELY PORTABLE
G.M. 150 KW A.C.
DIESEL GENERATOR SETS

SELF - CONTAINED PACKAGE UNITS WITH BUILT-IN SWITCHGEAR AND RADIATOR, MOUNTED ON OIL FIELD SKIDS



ENGINE: GM 110—6 cyl. GENERATOR: Delco 150 KW—187.5 KVA—208/240/416/480 volts 3 phase 60 cycle. 520/452/260/226 amps. Excitation 125 volts DC. Units are completely hooded, on oil eld skids, with tanks in base. With radiator & panel board. Just plug in for any of the above voltages. No piping or heat exchangers to hook up. Ideal for oil field use, marine construction, offshore drilling rigs, dredges, standby generators, etc.

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2—NEW—Allis-Chalmers—Bronze pumps, type SKH, 600 GPM. 300' hd., 5" Suc. 4" dis. coupled to Elliot steam turbine 60 HP. 3550 RPM. 190# steam pressure, 10# BP. Other pumps available.

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378 Bedford Avenue, Brooklyn 11, N. Y.

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HI-PRESSURE
Complete stock from 10-2,000 h.p.
Nation's largest inventory, New & Used
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AUTOMATIC and MANUAL
Gas or DIESEL GENERATOR UNITS
Complete Switchboard Design or Construction
USED & REBUILT EQUIPMENT
UNIVERSAL POWER ENGINEERING CO.
382 Wayne St. Jersey City, N. J.
Phone: DElaware 2-8300

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	900
450	440	Whse.	514
400 (3)	2300	G.E.	900
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
250	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2300/440	G.E.	720
150	250/440	Whse.	720
125	2300	G.E.	900

AC GENERATORS or SYN. MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300/440	G.E.	ATI	720
300	2300/4000	G.E.	TS	720
300	2300/440	G.E.	TS	1200
200	2300/440	Whse.	G	1200
150	440/230	Whse.	G	1200
150	440/230	G.E.	TS	900
125	440/230	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2300/4000	Elliott	SC	1800
350	2300/4000	G.E.	SBDP	3600
350	2300/440	G.E.	IE-K	1200
300 (3)	2300	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
300	2300/400	G.E.	KT	600
300	440/230	G.E.	KT	1800
300	2300	G.E.	KT	1800
300	2300	Cont.	THFC	3600
300	440/230	G.E.	KT	720
300	2300/440	G.E.	IE-K	1200
150	440	Whse.	X-prf.	3600
150	2300	Al. Chal.	RT	720
150	440/230	G.E.	THFC	720
150	2300/440	G.E.	AR	1800
150	2300/440		RT	900
150	2300/440	G.E.	FT	1200
135	2300/440	G.E.	K	600
100 (3)	4000/2300	L. Allis	OX	1200
100	2300	Cont'l.	THFC	3600
75 (3)	440	Wagner	THFC	1800

CIRCUIT BREAKERS, 3 Pole

1—4000 Amp., Whse., 600 V., Air, New
1—3000 Amp., R-Smith, 600 V., Air, New
4—1000 Amp., DA-50, Whse., 600 V., Air
6— 800 Amp., R. Smith, 7.5 KV, Sel. oper.
1— 400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	600
60/75	230	G.E.	CD	600/1500

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	440	Syn.	250
125	G.E.	440/230	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2300/440	Syn.	250
75	Cr. Wh.	440/230	Sq. Ca.	250/125
65	G.E.	2300/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al. Ch., 2400/4160Y—600 volts, 3 ph.
3—500 kva, G.E., 12800—2300 V.
3—333 kva, G.E., 2400-240/480 V.
3—333 kva, American, 2400—240/120 V.
3—250 kva, Al. Ch., 13,800—240/480 V.
1—200 kva, Al. Ch., 4800—220 V., 3 ph.
1—200 kva, G.E., 2400—120/240 V., Fyr.
3—200 kva, Mol., 13,800—2300 V.
3—200 kva, G.E., 13,800—480 V.
3—150 kva, Al. Ch., 2400—230 V.
3—150 kva, Al. Ch., 440-230 V., dry New
3—150 kva, G.E., 13,200—2300 V.
3—150 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E., 2400—120/240 V., Fyr.

GASOLINE—ENGINE GENERATOR SETS

2—35 kva, 900 R, 220 V, 3 ph. conn. LaMot, 6 cyl.
1—31 kva, 1800 rpm, 240/480 V., 3 ph., Fuel, 6 cy.

only partial listing

STEPHEN **HALL** & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

BOILERS

4—Keeler 200 HP, 160 psi, water-tube, w/acc.

COAL PULVERIZERS

1—Babcock & Wilcox #32E, 75 HP
1—Raymond 6-roll mill, 66" dia., 200 HP
3—Robinson #13 Sawtooth Crushers, 15 HP

COAL HANDLING CONVEYORS

4500'—16", & 24" all-steel trough rubber belt conveyor, complete units
150'-48" wide apron feeders

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DIESEL LOCOMOTIVE CRANES

(2) 25 Ton Orton w/Cat. D13,000
(4) 30 Ton Ohio w/Cat. D13,000
(1) 30 Ton Browning w/Cat. D13,000
(2) 35 Ton Ohio w/Cat. D13,000
(1) 40 Ton Orton w/Cat. D17,000

UNUSED DIESEL ELECTRIC SELF PROPELLED 50 PASSENGER RAIL COACHES.

SELLERS 57 FOOT PLATE EDGE PLANER, MFG. 1941

ALBERT HELLER
87 HAMILTON AVE. BROOKLYN 31, N.Y.
ULSTER 5-8643

GUARANTEED "REBUILT" POWER EQUIPMENT

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1250	*Al.-Ch.	ANX	3600
600	West.	CS	720
600	*G.E.	K-63455	1200
500	*G.E.	K-63455	1200
500	*G.E.	I-18-E	900
450	*G.E.	KT-559-A	1800
300	*G.E.	KG944	1200
250	*W (TE)	CS-81205	1800
250	*G.E.	KT-509-S	1800
250	*West.	CS-875-S	1800
250	Brook	RS28	1200
200	*G.E.	FT-540	3600
200	*G.E.	I-K-13B	1800
200	West.	CSP-581-S	1800
200	Brook	RS-27	1200
200	*West.	CS-930-A	900
200	G.E.	KT-564-B	720
200	*Al.-Ch.	AN-37-G	720
200	*West.	CS-1010	900
200	Al.-Ch.	ARW-681	600
150	Cr-Wh	SC-140	3600
150	Al.-Ch.	AN 30-F	1200
150	West.	CSP-5818	1200

M.G. SETS

Kilowatt	Make	Volts AC	Volts DC
1000	West.	4000	250
750	G.E.	4160	275
500	West.	440	250
400	Al. Ch.	2300	240
300	West.	2300	250
200	G.E.	2300	275
200	Ridgwy	2300	250
150	Al. Ch.	2300	275
150	West.	2300	250
125	Cr. Wh.	4160	125
125	G.E.	2300	250
100	G.E.	2300	250
100	Al. Ch.	2300	80
60	G.E.	220/440	250
40	G.E.	220/440	250

HUNDREDS OF BARGAINS
in
MOTORS, GENERATORS, CONTROL, HOISTS, COMPRESSORS, ETC.

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
2500	*G.E.	MT (Mill Type)	257
1100	*G.E.	MT	720
1000	*G.E.	M-579-S	1200
1000	*West.	CW	450
600	*G.E.	M-6345-S	1800
500	G.E.	M-6348	1200
400	*G.E.	MTP-585	1200
350	*Al.-Ch.	ARYW	1800
300	Cr-Wh	SR-70-R	1800
250	Al.-Ch.	ARY-626	1800
250	*G.E.	I-M-17A	720
200	G.E.	I-M-16	600
200	*West.	CW1950A	514
150	Cr-Wh	SR-50R	1800
150	G.E.	I-M-15A	600
125	G.E.	I-M-13A	600
100	G.E.	I-E-18A	1800
100	G.E.	MT558	720
100	G.E.	I-M-15A	425
75	West.	CW-770	1200

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CHICAGO *Electric Co.*

ALL TYPES OF EQUIPMENT IN STOCK

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Offers to purchase the undermentioned equipment will be received by the Deputy Minister of Public Works for the Province of Saskatchewan, Room 136, Legislative Building, Regina, Saskatchewan. The highest or any offer not necessarily accepted—

One—Wallsend Hewden Duplex fuel oil pumping and heating unit complete with controls, Capacity 750 G.P.H. each unit.

Eight—Wallsend-Hewden Air Registers, Guns and Sprayers.

Two—Westinghouse Motor Generator sets. A.C. Motors, 75 H.P. 220 volts 60 cycles. D.C. Generators. 55 K.W. 220 volt, 250 amps.

One—Generator switchboard, instruments and voltage regulator. New.

One—D.C. Motor and Starter. New condition.

For additional information contact G. E. STUHR, Chief Engineer, Power Plant, Legislative Building, Regina, Saskatchewan.

FOR SALE — EXCEPTIONAL BARGAINS

Diesel Generator Units, 200 KW-1500 KW — Turbo Generators, 500 KW-10,000 KW
Motor Generator Sets—Rotary Converters—Synchronous Condensers—
Frequency Changers—Transformers—Pumps, Boilers.

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FROM AIRCRAFT CARRIER
"ENTERPRISE"

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GEARED
TURBO-GENERATORS

For Condensing
or Non-Condensing

1000 KW TURBO-GENERATOR
COMPLETE WITH CONDENSERS
CIRCULATING PUMPS
CONDENSATE PUMPS
AND SWITCH GEAR

GENERATOR: 1000 KW—type ATB-2—G.E.—form H.L.—1250 KVA—3/60/450—1605 amps—3600 RPM—0.8 P.F.—field amps 87—typical serial No. 5358205—with 120 volt 11KW DC exciter—compound wound.

STEAM TURBINE: 1000 KW G.E.—type FSN-4R-FN30-85TG—rated 7964 RPM—exhaust 1 lb. absolute when condensing.

REDUCTION GEAR: S-118—form A—RPM 7964/3600.

TURBINE STEAM PRESSURE: 375 lbs—175°F superheat-exhaust pressure 1 lb. absolute when condensing. Can be used condensing or non-condensing.

BUILT AS MARINE UNITS USING FINEST MATERIALS. DRIP - PROOF CONSTRUCTION. UNITS ARE 16' LONG—7'8½" WIDE. MOUNTED ON PRE-FAB SUB-BASE.

OPERATING CONDITIONS

1. The turbines are designed for normal operation condensing at 375 lb per sq in gauge, 175°F superheat steam at throttle, and 1 lb. per sq. in. absolute at the turbine exhaust flange.
2. The turbines will operate successfully condensing at 375 lb. per sq. in gauge, 0°F superheat at throttle, and 1 lb. per sq. in. absolute back pressure at the turbine exhaust flange.
3. The units have an overload capacity of 25% (1250 KW, 0.80 p-f) for two hours with normal main and exhaust pressures.
4. The units have an overload capacity of 50% (1500 KW, 0.80 p-f) for five minutes with normal main and exhaust pressures.
5. The units will deliver normal output (1000 KW, 0.80 p-f) with main pressure 20% below normal and with a back pressure of 2 lb. per sq. in. absolute at the turbine exhaust flange.
6. The turbines will operate successfully with a maximum main pressure of 450 lb. per sq. in. gauge and with a maximum superheat of 200°F at the throttle.
7. The turbines will develop 500 KW with 375 lb. per sq. in. gauge, 175°F superheat steam at throttle, and 29 lb. per sq. in. gauge back pressure at the turbine exhaust flange.
8. The turbines will operate successfully when extracting steam from the second-stage shell of the turbine. An automatic pressure regulating valve and a non-return valve should be installed in the extraction line to hold the extraction steam at approximately 10 lb. gauge and to prevent a return flow of steam to the turbine.
9. The turbines will operate successfully with full steam flow to atmosphere.
10. The units will cover the entire range of conditions as listed above under automatic control of the speed governor.
11. The steam flow to the throttle is guaranteed not to exceed the amounts listed in Part V for the given loads when operating with steam at 375 lb. per sq. in. gauge at throttle, 175°F superheat, and 1 lb. per sq. in. absolute at the turbine exhaust flange. The guaranteed steam flows include the necessary steam for sealing the packing glands, and includes the electrical losses for the exciter fields and rheostats.

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ELGIN 5-5050 LEXINGTON 9-1900

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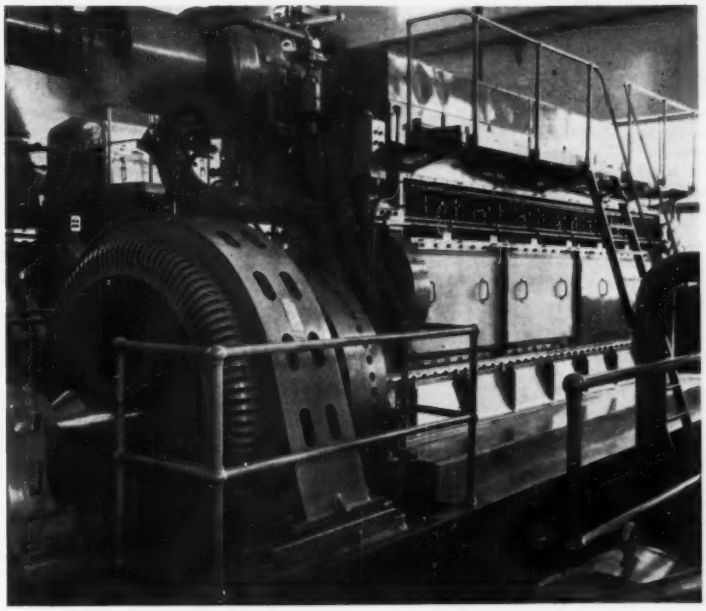
DUAL FUEL AND DIESEL ENGINE GENERATOR UNITS



ACTUAL PHOTOGRAPH 1250 KVA DUAL FUEL UNIT

1—1000 KW 80% PF 1250 KVA Electric Machinery generator, 3 phase, 60 cycle, 2400 volts (can be reconnected for 480 or 600 volts), 360 RPM direct connected to

1—1440 HP Worthington supercharged dual fuel engine, 4 cycle, fully enclosed, model SEHGO, 7 cylinder, 16" dia. X 20" stroke, 360 RPM

New 1951 — Excellent condition — Can be shown in operation.

2—1000 KW 80% PF 1250 KVA Electric Machinery generators, 3 phase, 60 cycle, 2400 volts (can be reconnected for 480 or 600 volts), 360 RPM direct connected to

2—1440 HP Worthington supercharged diesel engines (can be adapted for dual fuel), 4 cycle, fully enclosed, model SEH, 7 cylinders, 16" dia. X 20" stroke, 360 RPM

New 1949 — Excellent condition — Can be shown in operation.

1—840 KW 80% PF 1050 KVA Electric Machinery generator, 3 phase, 60 cycle, 2400 volts, 327 RPM direct connected to

1—1000 HP Nordberg supercharged diesel engine (can be adapted for dual fuel) type FS-166-22-SC, fully enclosed, 4 cycle, 6 cylinders, 16" dia. X 22" stroke, 327 RPM

New 1947 — Excellent condition — Can be shown in operation.

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1612 Union Commerce Bldg. · Telephone: MAin 1-9514 · Cleveland 14, Ohio

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1—300, 1—200 KVA, 3/60/4160-240 Wagners, ITE type HPB Outdoor Unit Substations.
2—250 KVA, 1/60/2400-240/480 Moloney, OISC, type YC, W/taps.
1—250, 4—150 & 2—100 KVA, 1/60/4160-120/240 Whse. Inerteen w/taps.
2—50, 6—37½ KVA, G.E. 1/60/2400-120/240 OISC.
5—25 KVA, WHSE. 1/60/2400—240/480 OISC.

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BENSON-WILIMZIG, INC.

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Will sell turbines separately if desired.

Price reasonable.

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. De ROSE
2457 WOODWARD AVE.
706 DONOVAN BLDG.
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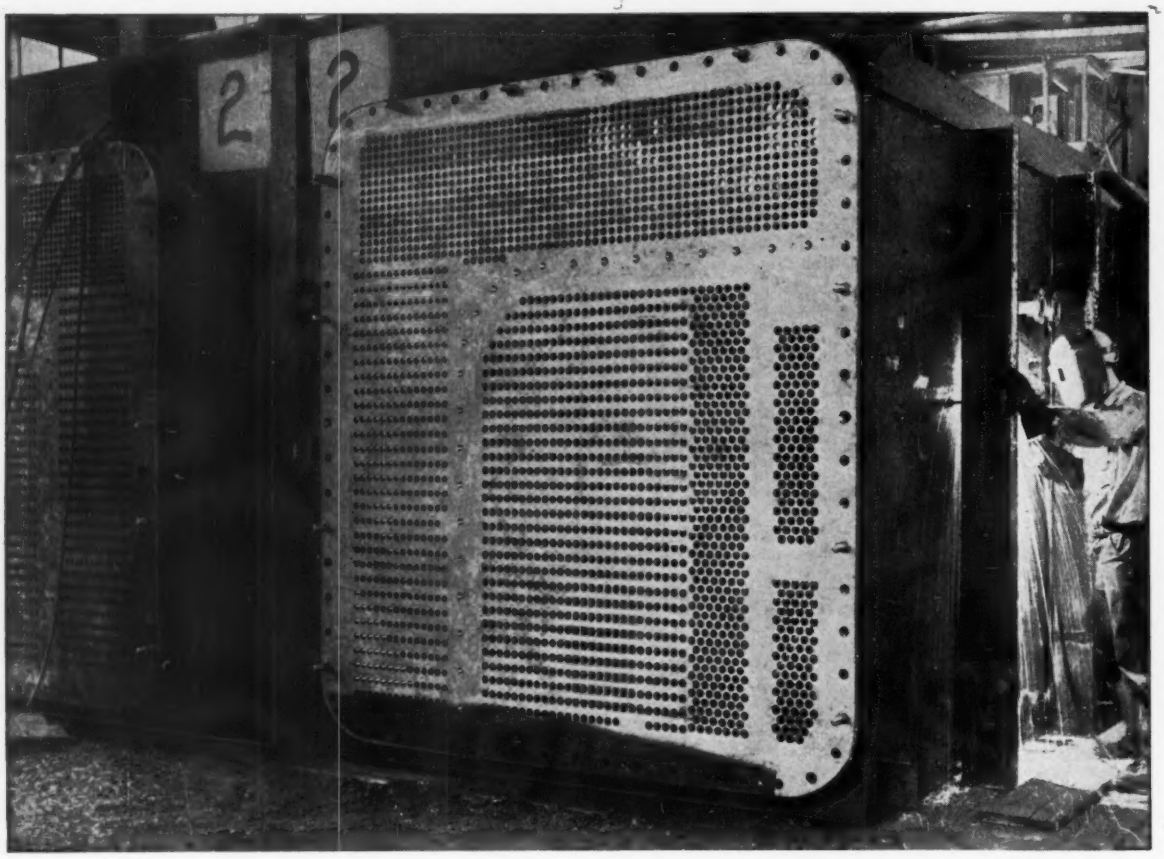


C.H. Wheeler Reverse Flow Condenser prior to installation at Savannah Electric & Power Company's Riverside Station. Reverse Flow principle could save Savannah hundreds of dollars: leaves, twigs, algae and other foreign matter can be flushed from tubes and tube sheets without shutting down the unit.

BECAUSE Reverse Flow design eliminates hours of costly down time

C.H. WHEELER CONDENSERS SAVE YOU MONEY

Let's suppose the condenser tubes and tube sheets in your station become clogged. If your condenser is of conventional design and serves a 200,000 kw turbine, you'd need many hours to clean the tubes, and each hour you spend could cost as much as $330!*

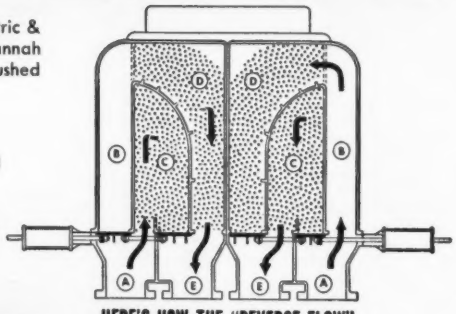
But with C.H. Wheeler's Reverse Flow design, you could flush away debris in a few minutes without shutting down the Condenser!

Reverse Flow is only one of the features of C.H. Wheeler Dual Bank Surface Condensers which save you money. Other money-saving features which result from Wheeler's 55 years experience in designing and building Condensers and auxiliaries, include better tube sheet design and advanced engineering of Tubejet® Steam Jet Ejectors, Condensate Pumps and Circulating Pumps.

*Based on an estimated cost of $8,000 per day for shutdown of a 200,000 kw Turbine-Generator.

C.H. WHEELER SAVES YOU MONEY IN THESE WAYS, TOO:

- Pure condensate
- Lower absolute pressure, higher vacuum
- "Zero" condensate temperature depression
- Deaeration to 0.03 cc. of oxygen per liter. (Special design provides for deaeration to 0.01 cc. per liter.)



HERE'S HOW THE "REVERSE FLOW" PRINCIPLE WORKS

Left Side Shows Normal Operation: Water enters inlet A with right port open, flows through tube bank C to rear of condenser; then it returns through tube bank D to front of condenser and discharges at point marked E.

Right Side Shows Reverse Flow: Sluice gates move on a common stem. Water flows up through channel B, through tube bank D to rear of condenser; returns through bank C to front of condenser.

In the C.H. Wheeler Divided Water Box design each half of the condenser can be back-flushed independently of the other; or both halves can be back-flushed simultaneously, with one or two circulating pumps operating.

C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Products

Fig. 8001 Screwed Ends. Sizes ½" to 2"
Fig. 8002 Socket Welding Ends

A New Lunkenheimer Valve

CHECK THE FEATURES OF THIS LUNKENHEIMER FORGED STEEL GATE VALVE

This new Lunkenheimer Forged Steel Gate Valve is already building a reputation for rugged service. Completely new in design, it's compactly built for fast installation in the most cramped quarters. Produced with famous Lunkenheimer materials and highly-skilled workmanship, it handles pressures of 800 lbs. at 850°F., and 2000 lbs. at 100°F. easily and safely. Discs are 13 Chrome Stainless Steel, heat treated completely through to 500 Brinell hardness to eliminate chipping or cracking. Rolled-in Seat Rings can't work loose. This newest addition to the world-famous Lunkenheimer line can help solve *your* valve maintenance problems. Call your Lunkenheimer Distributor, or write us for literature. The Lunkenheimer Company, Cincinnati 14, Ohio.

BRONZE • IRON • STEEL • PVC

L-1057-4

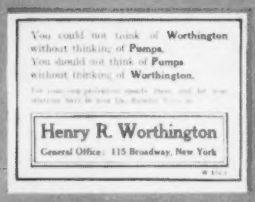
LUNKENHEIMER L QUALITY

LUNKENHEIMER®
THE ONE *Great* NAME IN VALVES

For more facts circle 202 on Reader Service Card, p 122

1889 Worthington Steam Pumps were subject of first Power ad. Copy stressed new improvements "exclusively" the property of the "Original Inventors."

1898 Worthington Self-Cooling Condenser guaranteed large fuel savings or corresponding increase in engine power to "accomplish result sought for."


You could not think of Worthington without thinking of Pumps.
You should not think of Pumps without thinking of Worthington.
Henry R. Worthington
General Office: 115 Broadway, New York

1912 Henry R. Worthington said, "You could not think of Worthington without thinking of pumps. You should not think of pumps without thinking of Worthington."

1918 Worthington Pumps promise to help "conserve manpower, coal and machinery," watchwords of the nation during World War I.

1928 150,000 sq. ft. of Worthington Condensers were installed in Hell Gate Station of United Electric Light & Power Co. to supply electricity to New York City and suburbs.

1925 Diesel Engine Line was designed with "skill and forethought" to reduce required attention to a minimum. The line was "built by men who know their business."

Nearly A Century
of progressive effort, research and experience have made and kept the name WORTHINGTON synonymous with PERFORMANCE and SERVICE in the power equipment field throughout the world.
WORTHINGTON

1934 Performance and Service—in the power equipment field—added up to "nearly a century's" worth of research, progressive effort, and experience.

HOW POWER HAS CHANGED IN 70 YEARS

This is Worthington's 1000th advertisement in the pages of POWER MAGAZINE

We have been telling you about our products in *Power* magazine over the last 70 years. This has been a communications job of increasing importance to Worthington, matching the growth of your industry needs and of our related business. Let's look back at these last 70 years of progress and change.

In 1889 Henry R. Worthington ran his first advertisement in *Power* to "solicit correspondence" on his "new and important pump improvements." He ran his twenty-second ad the year the battleship Maine was sunk. Worthington Pump and Machinery Corporation ran number 212 during World War I. And World War II saw Worthington Corporation's 859th ad appear in *Power*. Last month you read our 999th, fittingly enough on the most modern power service —the nuclear field.

We look forward to our next 70 years of successful and helpful communications. Worthington Corporation, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ontario. 109-27

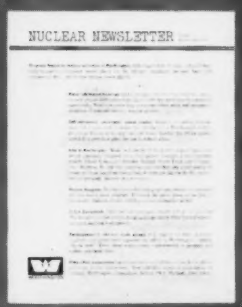
WORTHINGTON

1936 Worthington Compressors were operating in thousands of plants, helping keep "air-operated equipment on the job" for economical production.

1939 De-aerating Feedwater Heaters, providing fuel-saving efficiencies, were built to individual plant requirements. Engineering assistance available, of course.

1943 QD Sheaves were no problem to "green help" of World War II. Even women could assemble them regardless of size because of easy-on, easy-off design.

1953 Modernizing Power Plants —this one at Iowa State College— was the "undivided responsibility" of Worthington turbine-generator engineers and specialists.



1959 Nuclear Newsletter published last month told of Worthington's advances in the nuclear field, from basic theory through modern manufacturing facilities.